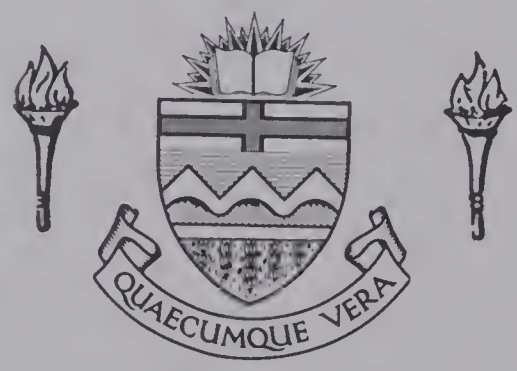


The University of Alberta
Printing Department
Edmonton, Alberta

THE UNIVERSITY OF ALBERTA

WATERFOWL UTILIZATION BY A GROUP OF SLAVE INDIANS, A PREDATOR-PREY RELATIONSHIP

by

ALEXANDER JAMES MACAULAY

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF ZOOLOGY

EDMONTON, ALBERTA

APRIL, 1968

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled Waterfowl Utilization by a Group of Slave Indians, a Predator-Prey Relationship submitted by Alexander James Macaulay in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

The utilization of natural resources by a group of Slave Indians at Habay, Alberta was investigated. The study was conducted during the summers of 1966 and 1967. Of the available wildlife, waterfowl were the most heavily utilized. Grouse, large mammals and some small mammals were used as minor food sources.

In their waterfowl hunting activities the Slaves were comparable in many respects to natural predators. They displayed standardized hunting techniques, numerical and functional responses to changing prey densities, and they ceased hunting when the prey density fell below the "threshold of security" of specific prey species. Hunting efficiency was calculated as 46.1 per cent in 1966 and 37.2 per cent in 1967. Crippling losses each year were about 2 per cent. Lower efficiency in 1967 was associated with increased wage earning incomes, and the resulting decrease in dependence on waterfowl as a source of food.

Extensive utilization was made of the harvest, and any material which was not used for human food was employed in a cultural context or fed to the dogs. The man-dog relationship resembled the predator-scavenger relationship.

Fish are used as dog food. The harvest of fish, taken almost exclusively with hook and line, in 1967 amounted to 5,366 lbs.

Other than trees, which were used as firewood, utilization of plant resources was not extensive.

ACKNOWLEDGEMENTS

To my supervisor, Dr. D. A. Boag, I wish to express my deepest appreciation for his encouragement and advice, which were available and readily offered whenever necessary. To the other members of my committee, Dr. V. Lewin and Mr. B. Cox, I am grateful for the suggestions and comment which they offered for the improvement of the manuscript.

To the Alberta Forest Service, and in particular, Mr. H. R. Winn, Superintendent of Footner Lake Forest, and Mr. E. F. Doll, Forest Officer at Hay Lakes, I owe a special note of thanks for their invaluable co-operation and the use of the facilities at the Hay Lakes Ranger Station.

Thanks is also due to the Indian Affairs Branch, especially to Mr. Bill Rees, Superintendent of the Fort Vermilion Indian Agency, and Assistant Superintendent Mr. Dennis Lowing at Hay Lakes, for lending assistance in every possible way and making all the required information in their files available to me.

Mr. John Love, manager of the Hudson Bay Store at Habay was equally willing and co-operative in aiding me in the study. For this I am greatly appreciative.

To the residents of Habay Mr. and Mrs. E. F. Doll, Mr. and Mrs. D. Lowing, and Mr. and Mrs. John Love, I would like to express my gratitude for the kindnesses and hospitality extended to me.

The companionship of Mr. C. D. Kelland was much appreciated, and I wish to thank him for collecting data in my absence.

I am grateful to Mrs. Barbara White for the final typing and editing of the manuscript, which she did so capably.

Finally, I would like to thank the members of the Slave Band at Hay Lake for allowing me to conduct the study and for the knowledge and appreciation I gained of their way of life.

Financial support was provided by two summer grants from the Indian Affairs Branch, as well as a graduate teaching assistantship from the University of Alberta during the winter of 1967 - 68.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

In order to describe the relationship between a group of Slave Indians and a population of waterfowl as predation it is desirable to define the term as it is used in this study.

Predation is an interspecific relationship in which members of one population kill members of another in response to the former's immediate food requirements. Because this phenomenon occurs throughout the animal kingdom (Gause, 1934; Huffaker, 1958; Tinbergen, 1960; Mech, 1966), and because it grades into parasitism (Odum, 1964), its characteristics vary. Within the vertebrates, however, predator-prey relationships have many common characteristics. These features are usually described in terms of the predator, the animal which does the killing.

One characteristic is the response of the predator to changes in the density of the prey. This response has two components, a functional and a numerical one (Holling, 1959). A functional response is seen in the tendency for the predator to take more of the prey as prey density increases. This results from an increased opportunity for predator-prey interaction. The relationship, however, is curvilinear, because the proportion of prey taken by the predator declines with increasing prey density. The second component of the response, termed numerical, is the change in the number of predators which occurs as prey densities change. There may be an increase in the

predator population through immigration or reproduction following an increase in prey populations. Conversely the number of predators may decrease through emigration or increased mortality following a decrease in prey populations.

The total response shown when the above two factors are acting simultaneously may be one of two types. The per cent of predation may rise steadily as prey density increases, or there may be an initial increase in predation, with a gradual levelling-off as prey density continues to rise (Smith, 1966).

Another feature of predator-prey interactions is the cessation of predation when prey density reaches a critical level. Below this critical density, termed the "threshold of security" (Errington, 1946), the predator finds it no longer profitable in terms of energy expended to hunt that prey species. When such a situation confronts a predator, there are three possible outcomes: the predator will decline in numbers; it will move to areas of greater prey density; it will shift to other sources of food. The choice of alternatives depends on the mobility of the predator, proximity of higher prey concentrations, and the ability of the predator to take alternate prey species.

In this study, I shall describe a predator-prey system which displays the above characteristics.

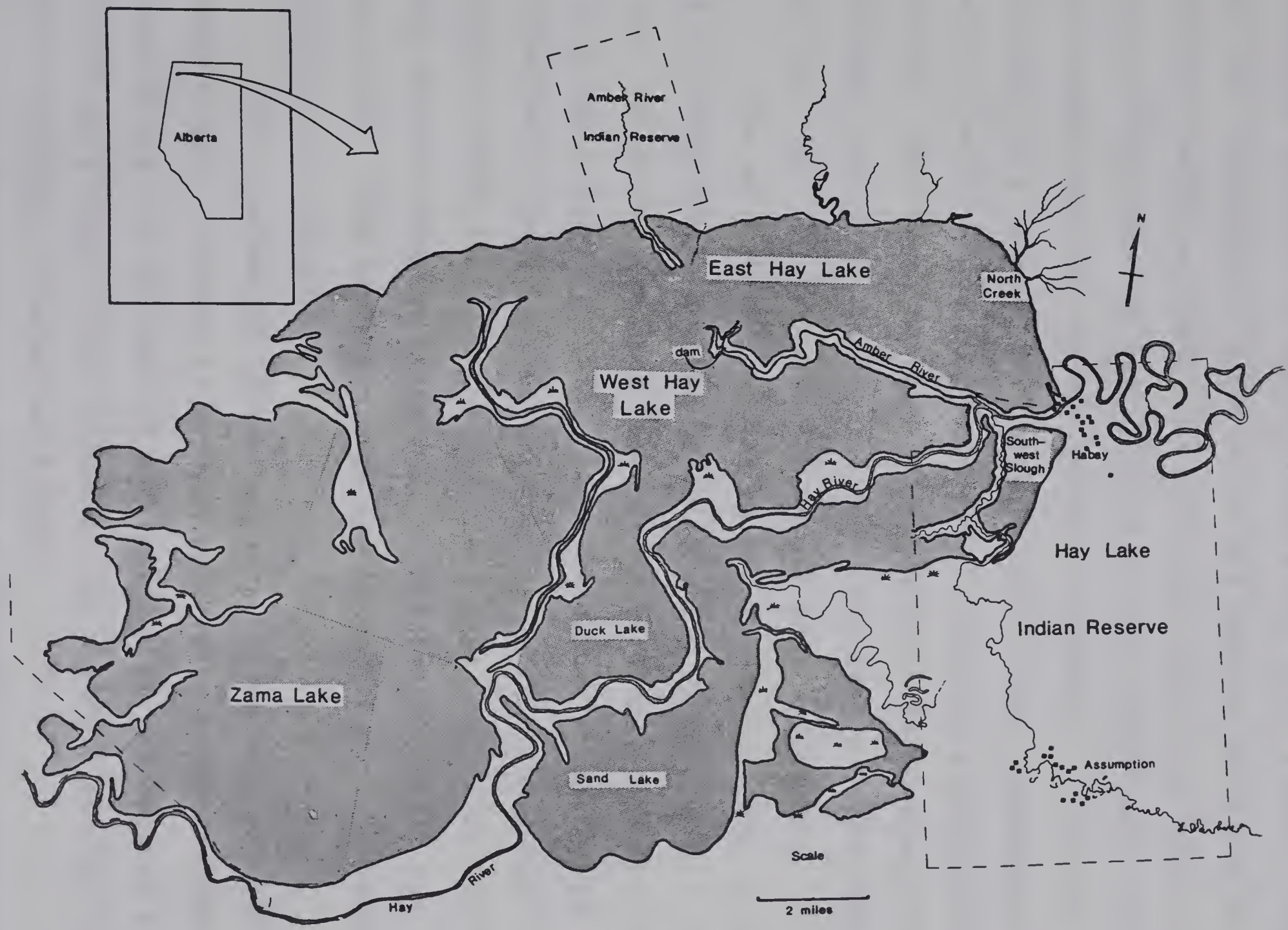
The predator population in this study was part of a band of Slave Indians in Northern Alberta, while the prey populations were mainly species of waterfowl which they utilized as a source of food during the season of open water.

This project was initiated to obtain information on the extent of utilization by the Slaves of the natural resources of the area and the importance of these resources in their summer economy. The study was centered around a small band of Slaves residing at the settlement of Habay (58°49'- 118°45'N). This village is at the north end of the Hay Lake Indian Reserve (Fig.1); at the south end of the reserve is the larger settlement of Assumption. Habay has a resident native population of approximately 120, Assumption about 575. During the summer, the population at Habay increases to about 175. Some of the Assumption residents move there to take advantage of the abundant supply of fish and waterfowl. Of the 120 permanent residents at Habay, there are about 34 potential hunters, with 26 men who could be termed active hunters.

Historically, the Slave band resided in smaller groups on the Zama Lake Reserve and along the Hay River, both upstream and downstream from the present site of Habay. The establishment of the Roman Catholic mission at Assumption and the construction of the nursing station at Habay tended to concentrate the natives in the two settlements; the Zama Lake Reserve is now abandoned.

Prior to the development in 1963 of the Rainbow Lake oilfield located 25 miles south of the reserve, the Hay Lake Indians were quite isolated from the effects of white civilization, save for the influence of the Indian Affairs Branch, the Hudson's Bay store at Habay, the nursing station, and the mission. With

Figure 1. Map of Hay Lake region.


Alberta
Amber River
Indian Reserve
East Hay Lake
North Creek
N
dam
Amber River
West Hay Lake
South-west Slough
Habay
Hay River
Hay Lake
Indian Reserve
Duck Lake
Zama Lake
Sand Lake
Assumption
Scale
2 miles
Hay River

increased activity in the oilfield since 1963, however, there has been considerable exposure to the dubious qualities of the transient white workers. In addition, there have been increased opportunities for the men, especially the younger men, to find employment with the oil and seismic companies. This has changed, to a considerable degree, the natives' dependence on natural resources for a livelihood. Personal correspondence with Mr. John Love, Manager of the Hudson's Bay Company store at Habay, verifies this fact; there has been a steady decline over the past few years in the amount of trapping done.

The main dialect spoken by the people is Slave, a branch of the Athapaskan language group (Wissler, 1966 p.200). There are a few Beaver and Cree families in the population, but they are a small minority. The native language is still used extensively, almost exclusively by the adults, while most of the younger people have learned to speak, read, and write English. This results from the efforts of a residential school and, in many cases, from prolonged exposure to English in the Edmonton tuberculosis sanatorium.

The standard of living is low compared with that in white communities; a survey by the Indian Affairs Branch in 1966 revealed that 50 per cent of the families on the reserve had incomes of $1,000 or less annually, while only 6 per cent had yearly earnings in excess of $3,000.

The main sources of income at present are: band-sponsored projects, such as fencing the reserve and cutting firewood; individual employment in the oilfield; forest-fire fighting; and

as assistants and laborers with the mission, Hudson's Bay Company, nursing station, and the Indian Affairs Branch.

Most of the families still live in log houses during the winter months, moving into tents and "summer teepees" to escape the summer heat.

The main source of transportation on and around the reserve is still horses in summer and dog teams in winter, although the number of automobiles and "motor bikes" has increased greatly in the past two years. The latter are a manifestation of the increased wage-earning opportunities in the past three years. Water transportation is mainly by canoe, originally manufactured from spruce bark, but in recent years completely replaced by commercially-produced craft. This, again, is a result of the increased "affluence" of the natives. There are only two outboard engines in use at Habay; both of these belong to one man.

For the most part, the natives do not cultivate gardens, although the soil is fertile and capable of producing good vegetable crops. The mission farm, for example, produces excellent gardens each year.

Thus, the Slave Indians at Habay have neither a wage-earning nor an agriculture-based economy which is sufficient to support them; rather they still have a hunting and gathering form of society, which as I shall attempt to show, depends heavily on the natural resources, and particularly, the waterfowl, of the area.

One might logically ask if a comparison between man and predatory animals is justified, since man seems "so different" from other animals. To answer this question, it is necessary to determine what makes man unique. The obvious distinction is made on the basis that man has the ability to reason, to communicate ideas, and to manufacture and use tools. In short, man posseses a culture, which Honigmann (1963, p.3) defines as the sum total of a society's man-made artifacts, behavior-patterns, ideas, and feelings, which all enable man to cope more effectively with his environment. Thus a hunting and gathering society, such as that of the Slaves, can be looked upon as a population of predators with one important addition, culture. This culture enables the Slaves to greatly improve on innate hunting abilities, making them, in effect, a population of "super-predators".

The prey populations upon which these people rely heavily during the summer are the various species of waterfowl which use the marsh areas of the lakes as a summer moulting ground and as a resting place on spring and fall migrations. To a much lesser extent, the area is utilized as a breeding ground by ducks. There are twelve species of ducks and three of geese that occur regularly at Hay Lake, the geese being only migrants in spring and fall.

The waterfowl population varied from season to season, as well as from year to year. It was typically highest during migration.

Three species of fish appear to spawn in East Hay Lake, as fingerlings of pike (Esox lucius), walleye (Stizostedion vitreum), and burbot (Lota lota) were found there. In early June, as the waters in the lake begin to recede, the adult fish move into the rivers, where they concentrate in large numbers.

It is evident, therefore, that the Slave Indians at Habay, the predators in this dissertation, live in proximity to an abundant wildlife resource. I propose to examine both the predator and the prey populations in order to demonstrate the presence of many of the characteristics displayed by other predator-prey systems.

PROCEDURE

In order to achieve the objectives, it was necessary to learn the characteristics of the predator and the prey populations involved. Because the opportunity for experimental manipulation did not present itself, the procedure employed was observational.

In examining the predator population, the number of predators involved is of prime concern. Through close association with the hunters, in the village as well as on hunting trips, it was a relatively simple matter to determine who amongst the men were active hunters. Estimates of the distance travelled to hunt and the general area hunted were similarly obtained through conversation with the men and by accompanying them on hunts. Specific hunting techniques and success of the hunters was recorded while in the field with the men. Evidence of selection in hunting activities can be gained in two ways; either by direct observation of hunters, or by comparing the composition of the harvest with that of the available prey populations. An attempt to demonstrate a threshold of security can be made by comparing intensity of hunting activity with relative availability of prey.

Information on the prey populations was obtained both while in the field with the hunters and on separate waterfowl censuses which were conducted regularly. In both instances, relative availability and species composition were recorded by noting the number and species of birds that flew within a specified distance. I arbitrarily chose an estimated distance of

50 yards, since this was the distance at which birds were considered within shooting range by the Indians; this was also optimal distance for species recognition. Data on relative abundance of birds throughout the lake complex were obtained from aerial surveys flown at regular intervals during the summer, as well as from impressions gained while travelling the area on foot or by boat.

Information on the magnitude of the waterfowl harvest, species and sex of birds involved, and the average kill per hunt were obtained by collecting wings from birds killed by the hunters. Both wings were collected from each bird to prevent duplication in the recorded kill. Species and sex identifications were based on Carney, 1964. Because the wings were normally used for dog food, a token sum of 10 cents per pair was paid to help purchase packaged dog food from the local store. It could be argued that this sum might either provide an incentive to hunt or contribute to the family income, thus enabling the hunters to buy more shells. However, from the following observations, I believe it did not. The people did not seem to use this wing payment for any specific purpose. It was spent frivolously. I observed in most instances that the money was given to the children and they bought candy, soft drinks, or other treats, which they would not normally be able to afford. Furthermore, assuming that a hunter shot 25 ducks with a box of 25 shells, he would receive $2.50 for the 25 pairs of wings. Such a success ratio

was rarely realized, and even if it were, this sum would only represent one-half of the price of a box of shotgun shells at the local store.

The taking of large mammals was a sufficiently important event in the village that, even if I was not present when an animal was brought home,I was informed in short order "via the grapevine". It was then a simple matter of verifying the age, sex, species, and the approximate location of the kill.

In the summer of 1966, fish were caught almost exclusively with nets, and it required observing the catches when the nets were lifted, or questioning the fishermen, in order to obtain data on the harvest of fish. In 1967, however, the pattern changed, and most of the fish caught were taken with hand lines. Because of the short duration of the fishing season and the small number of fishing sites utilized, it was possible to be present most of the time and record the catches.

It was desirable to obtain some measure of the total poundage of fish taken, but because of the rapidity with which fish were being caught, it was impossible to weigh each one, so an arbitray classification system was used. I grouped fish in size categories by estimated length, and assigned weights to these size classes from a known sample of fish which had been weighed and measured. These classes are described in Table I.

TABLE I. Size categories of fish, used in recording harvest of fish in Hay River, 1967.

Class	Length	Weight
I	<24"	4- 6 lbs.
II	25 - 30"	7-10 lbs.
III	31 - 37"	11-19 lbs
IV	>38"	>20 lbs.

By totalling the number of fish in each size class and multiplying this figure by the median weight for that size class, it was possible to arrive at the approximate poundage of fish taken.

I also wished to obtain some idea of the minimum frequency of catches for which the natives considered it profitable to continue fishing. As an index to availability, I tried to mimic the Indians' fishing technique, using the same tackle, the same length and frequency of casts, and the same type of retrieve. Samples using this technique were taken regularly in the areas of main fishing activity. All fish caught were returned to the water after being landed. Availability is expressed as the average number of casts per fish caught.

The use of plants by the Slave Indians is not extensive and so all information which I could gather on this phase of resource utilization was obtained in the course of daily association with the people.

RESULTS AND DISCUSSION

Waterfowl

Of several prey populations available to the Slave Indians, waterfowl were the primary prey species during the open water period.

The Slaves kill waterfowl in a number of ways, the method varying with the season. In spring and fall, the main method is to shoot the birds on the wing with a shotgun. The hunters go out in groups of two or three to areas of known waterfowl concentration and station themselves in patches of vegetation affording good cover. They then simply wait until birds fly within shotgun range.

In hunting ducks by this method, no attempt is made to lure them with calls or decoys, as this is generally unwarranted. More effort is exerted in hunting geese, however, as the hunter attaches greater significance to the killing of a goose than of a duck. Presumably this is a function of the greater amount of food represented by a goose carcass, but there also may be a prestige value involved. I think this is probably associated with the fact that geese are harder to get, by virtue of their natural wariness as well as their relative scarcity. It is a matter of some pride to the hunter to be able to go out and kill geese consistently.

That greater effort is expended in obtaining geese is illustrated by the longer distance the men were willing to travel and by the greater preparation involved in goose hunting.

Of 29 hunts during the summer season when geese were absent, the average straight-line distance travelled to shoot ducks was 1.1 miles, whereas of 13 hunts in the fall, ostensibly to shoot geese, the average distance travelled was 4.6 miles. In the latter cases, most of the trips were made to the area of the dam on the Amber River (Fig. 1), where the geese were concentrated. Ducks were also more abundant there than on East Hay Lake. Since this concentration of ducks was not exploited until geese were also present in the area, it appeared that this was not sufficient reason in itself to warrant the much longer trip to the area of the dam.

The duck hunter always chose an area which provided sufficient vegetation in which to hide, whereas the goose hunter appeared to choose the areas where the geese were concentrated, irrespective of available cover. If the cover were too sparse to afford concealment, a blind was constructed of willow branches, which might have to be carried a mile or more to the hunting site. Typically the blind was constructed of willows eight to ten feet high which were stuck into the mud in a circular pattern just large enough to conceal a crouching man. The top two feet of the branches were broken and bent downwards so that the leafy tops would provide additional cover. Although decoys were never seen to be used, the men were very adept at imitating the calls of geese, and they readily employed this technique to lure the birds within shotgun range.

For all waterfowl hunting, a 12 gauge shotgun is preferred, but 16 and 20 gauge guns are also used. Commercially produced shells with number 4 shot and standard powder loads are used exclusively; none of the men reload their own shells.

During the summer of 1966 when there were large numbers of flightless birds on the lakes, a different and usually very productive method of hunting was witnessed. It took the form of an organized hunt involving 8 to 15 men. The men left the village in the morning and travelled to one of the areas where large numbers of moulting and young ducks had been observed previously. The men formed a long line of 'beaters', walking through the emergent vegetation parallel to the shore and driving the flightless birds ahead of them. When a sufficiently large number had been 'herded' together, the birds were driven to shore and killed with sticks or shot. The success of these hunts was usually high.

Mr. George Mercredi of Habay described two other methods of hunting (Boag, pers.comm.). Neither method was observed during this study. Flightless ducks on the Amber River were harassed by men in canoes and were either clubbed to death with paddles while still in the water, or killed by accompanying dogs as the birds scrambled into the vegetation on the shore.

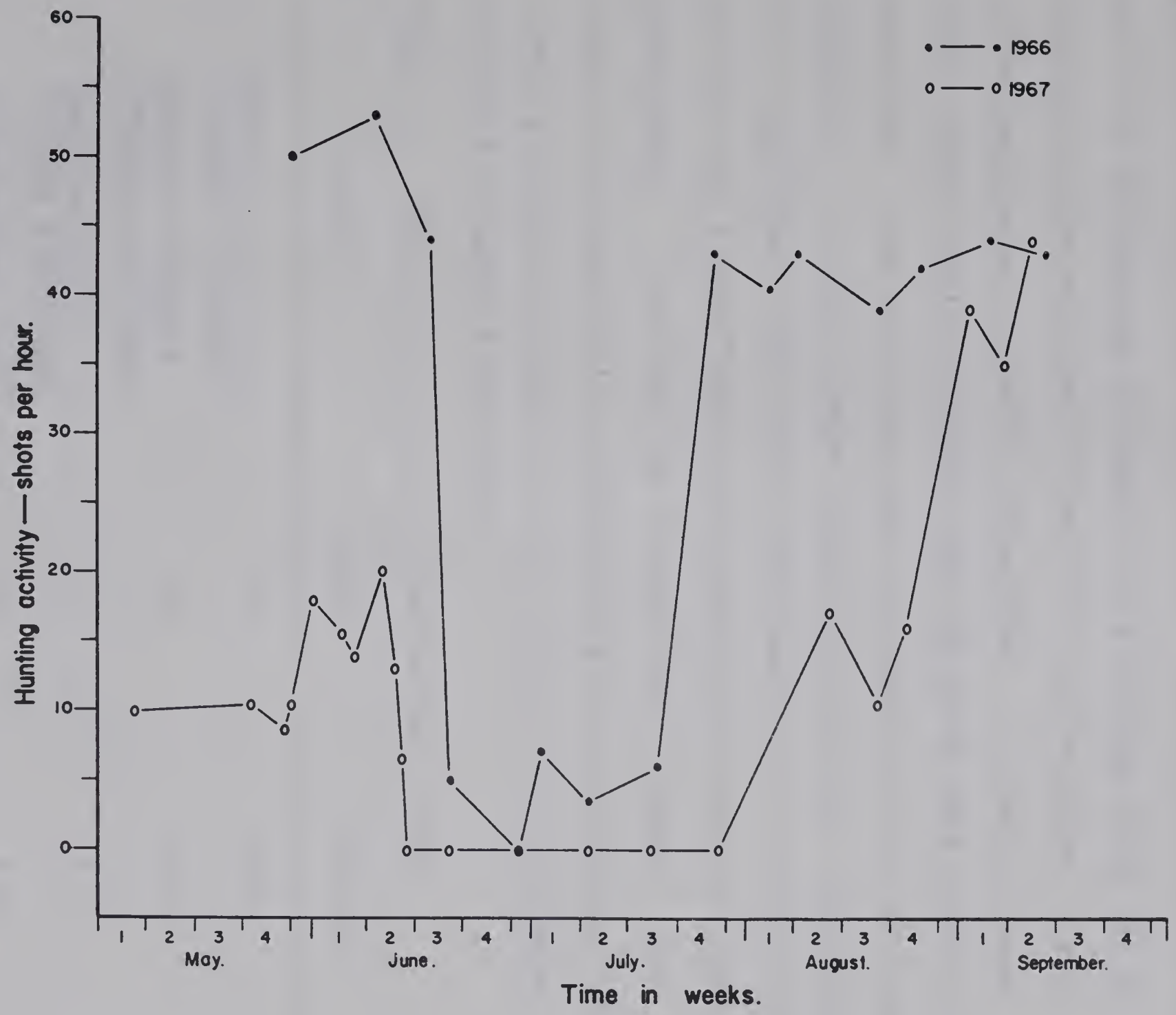
Ducks and an occasional goose were taken opportunistically by hunters or fishermen whenever travelling the river by canoe. The men invariably carried a shotgun, and they would shoot any birds which flushed from the banks within range.

Magnitude of the kill

During the summer of 1966, I was faced with the problem of gaining the confidence of the people. They feared that this study would lead to a curtailment of their hunting activities. For the first six to eight weeks the people were reticent in giving information. However, I felt that a close estimate of the waterfowl harvest was recorded for the period of August 1 to September 12 through the collection of wings. During this period, 3,069 pairs of wings were collected, with the total for the entire 1966 season being 4,347 pairs. Because the collections prior to August 1 were not representative, the discussion of the 1966 data will be confined to the August 1 to September 12 interval.

In order to estimate the 1966 waterfowl harvest, it is necessary to extrapolate from the August 1 to September 12 data. Figure 2 shows that the hunting activity can be separated into three approximate periods from May 20 to June 15; June 16 to July 26; and July 27 to September 12. It can be seen that hunting activity for the first and last periods is approximately the same. Assuming, then, no difference in hunting efficiency between spring and the late summer period, we can postulate that daily kills during the first and last periods were approximately the same. On the basis of the August 1 to September 12 harvest data, I arrived at a mean daily kill of 714 birds per day when the hunting activity was 40 to 45 shots per hour. By using this figure to calculate the total kill of the periods May 20 to June 15 and July 26 to September 12

Figure 2. Graph of seasonal hunting activity, 1966 and 1967.


1966
1967
Hunting activity — shots per hour.
60
50
40
30
20
10
0
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
May.
June.
July.
August.
September.
Time in weeks.

I obtained a value of 7,283 birds killed during these two periods of high hunting activity. For the period of low hunting activity, June 16 to July 25, it is not possible to arrive at an accurate estimate, but a minimum value can be obtained by the addition of the kills on the three co-operative hunts which occurred during 1966. On two of these hunts, participants estimated that 500 birds were killed on each hunt. The third hunt had a recorded kill of 326 birds (Table II). If the former figures are accurate, this would be an additional 1,300 birds, which would be an underestimate, as there was a small amount of hunting being done by some individuals. This would be insignificant, however, when compared with the kills contributed by the co-operative hunts. I thus arrived at a total kill for the May 20 to September 12 period of about 8,600 birds.

TABLE II. Results of one co-operative hunt, 1966

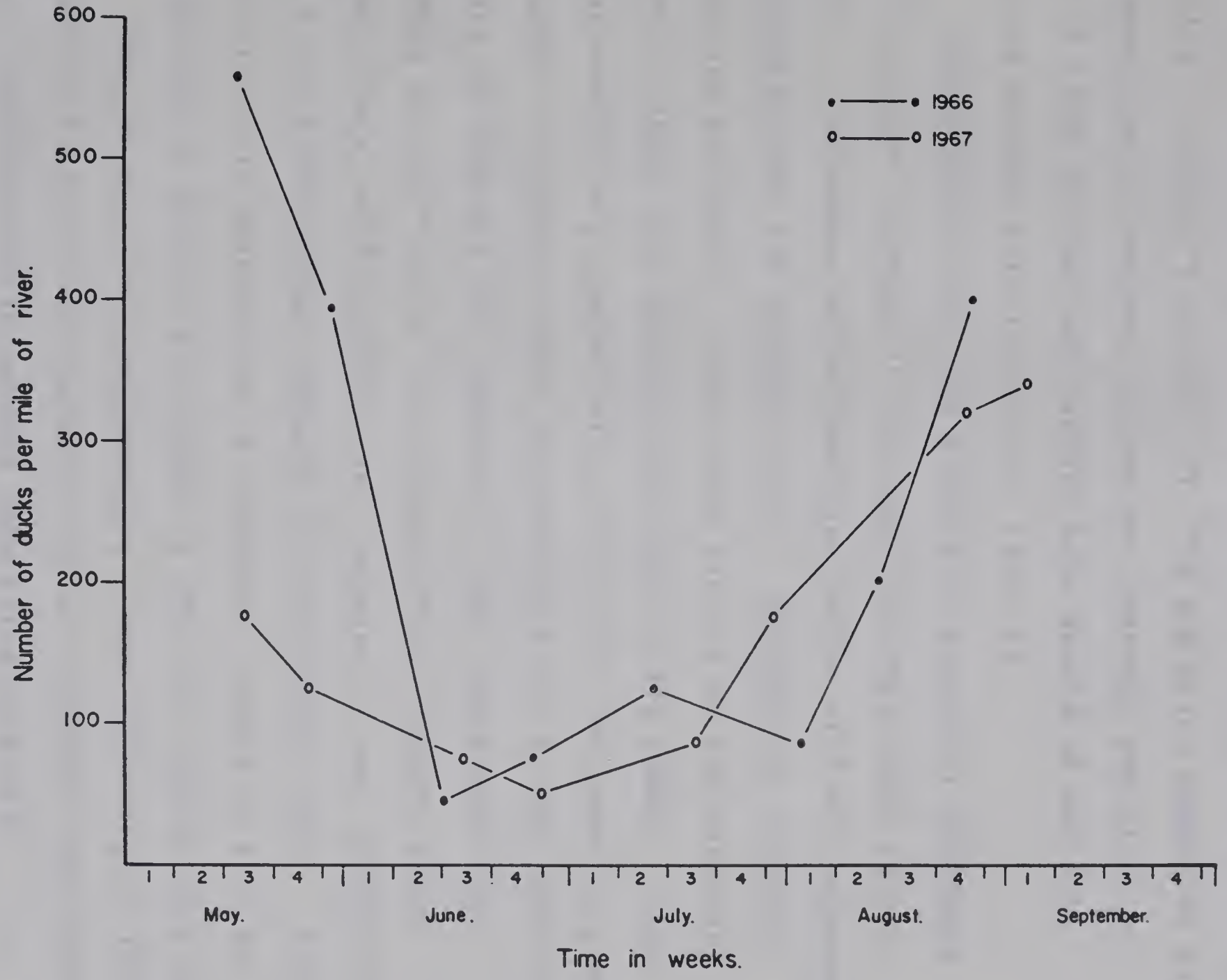
Species	Number	Per cent
Shoveler (*Spatula clypeata*)	106	32.6
American Widgeon (*Mareca americana*)	86	26.4
American Coot (*Fulica americana*)	57	17.3
Green-winged Teal (*Anas carolinensis*)	25	7.8
Blue-winged Teal (*Anas discors*)	20	6.0
unidentified ducklings	32	9.9
Total	326	

In comparing this with the total of 2,010 birds killed in 1967, there was apparently a considerable decline in utilization during the second year of the study.

This observation is supported by the decrease in the general level of hunting activity in 1967 (Fig. 2), as well as by the decreased number of campsites of hunters along the Amber River. It is a common practice on all-day hunts to stop and build a fire at mid-day and roast enough ducks to feed the hunters. Upon my arrival in the spring of 1966, seven such sites were found, with the remains of 45 ducks and geese present. In 1967, only two such sites were found, with five ducks being represented.

To explain this phenomenon of decreased utilization of a prey species, Errington (1946), suggests that one immediately looks for changes in the densities of predator and prey. In this study, the predator population remained constant; there was no significant change in either the total population or the number of potential hunters at Habay. The prey population, however, declined significantly. The only reliable index of abundance which can be compared for the two years is the average number of ducks counted per mile along the Amber River. In both years, counts were kept of the number of birds that flushed from cover or loafing bars along the river. Only birds that appeared to be loafing and which flushed within 50 yards of the moving boat were recorded. Figure 3 shows a comparison of the 1966 and 1967 censuses along the Amber River. Although the differences appear significant in the spring only, the lakes appeared to show the difference more markedly in the fall

Figure 3. Graph of waterfowl censuses on Amber River, 1966 and 1967.

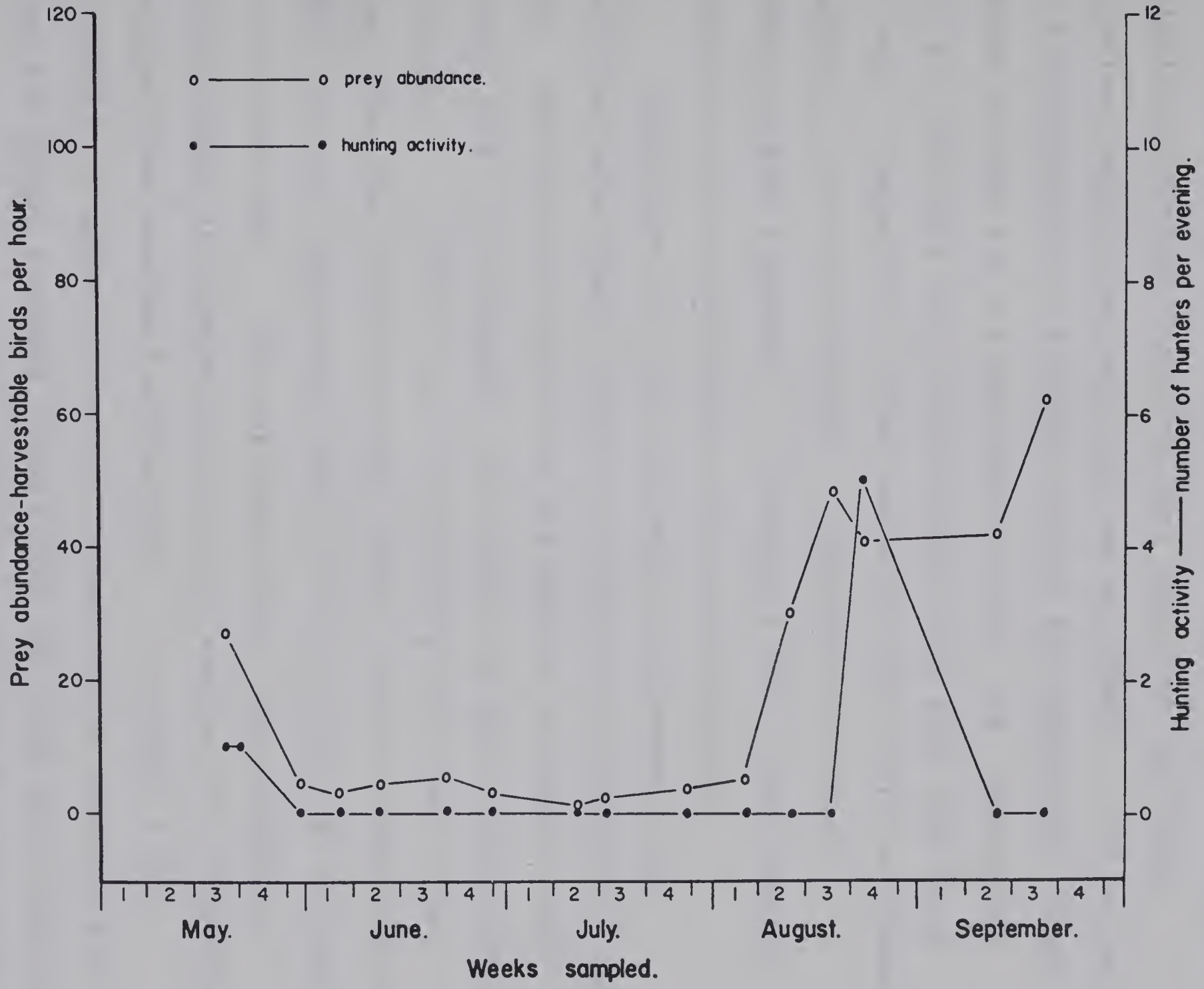

600
500
400
300
200
100
Number of ducks per mile of river.
1966
1967
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
May.
June.
July.
August.
September.
Time in weeks.

as well. For example, areas of East Hay Lake which had high densities of ducks in the fall of 1966 and which supported such high densities of hunters, 12 men per evening, and kills of 12 to 15 birds per man per evening were devoid of ducks in 1967, and hunting activity was nil (Fig. 4).

Coincidental with this decline in waterfowl abundance in 1967 was the increase in the amount of employment on the reserve. The number of men employed in the oilfield increased considerably over the previous year. Although no accurate figures are available, it was noted that 12 of the potential hunters at Habay were employed for most of the summer; these men had worked only sporadically, if at all, the previous summer. The number of projects which contributed wages to the families at Habay in 1966 was nil, whereas in 1967, there were four. According to the files of the Indian Affairs Branch, these yielded a total of $10,365.00, an increase of over $10,000.00 for a 4 1/2 month period compared to the previous year. Further support for this observation of increased incomes is a 61 per cent decline in welfare assistance in 1967 (D. Lowing, pers.comm.).

Thus we have two complementary events occurring in 1967, the decline in waterfowl abundance and an increased wage-earning income, the relationship between them being uncertain. It would appear that this is a cause and effect relationship. the natives have responded to decreased prey densities by creating work in the form of band projects and taking advantage of available jobs in the oilfields. However, it could be argued that the two factors are totally unrelated, and that the

Figure 4. Graph of hunting activity and waterfowl abundance at North Creek, 1967.

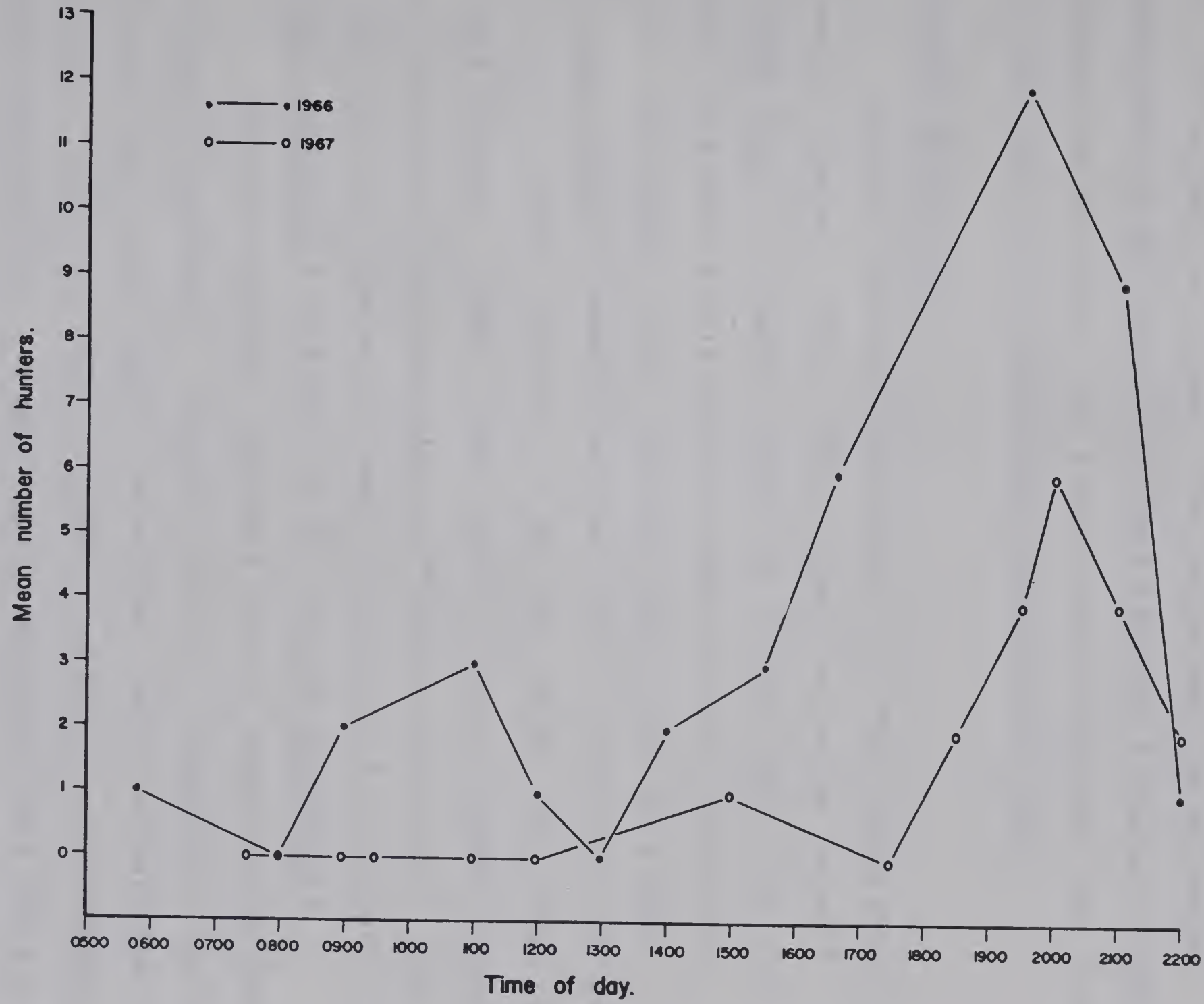

o ——— o prey abundance.
• ——— • hunting activity.
Prey abundance-harvestable birds per hour.
Hunting activity ——— number of hunters per evening.
120
100
80
60
40
20
0
12
10
8
6
4
2
0
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
May.
June.
July.
August.
September.
Weeks sampled.

Indians are merely experiencing an acculturation process which leads to an acceptance of wage labor. I believe that this latter explanation is in part true, but declining waterfowl populations have also had an effect. This process of acculturation was hastened because the traditional summer source of meat was not available in 1967, and, because the men did not spend their time hunting, they were free to go to work. Regardless of the reason for this shift in economic emphasis, the Slaves display an opportunistic behavior common to many predators. Errington (1967) cites numerous examples of the opportunistic aspects of predation.

Associated with this decrease in dependence upon waterfowl were several changes in the hunting patterns of the men. Hunting activity during the daytime decreased significantly (Fig. 5), presumably this being the period spent working for wages. In 1967 very little hunting took place at any time other than in the evening, whereas Figure 5 shows that in 1966 there was considerably more activity at mid-day and even in early morning. This may also reflect the concensus of opinion among the hunters that hunting was best in the evening because birds were most active then. In a year of low abundance, it would not be profitable from the standpoint of time and energy expended to hunt when the birds were inactive.

It was observed also that the attitude of the hunters toward the killing of game changed perceptibly in 1967. In general the men appeared to shoot more frequently at birds that were beyond effective shotgun range and to accept misses in a much less serious manner than in the preceding year. I think

Figure 5. Graph showing daily hunting pattern of men, 1966 and 1967.


1966
1967
Mean number of hunters.
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0500
0600
0700
0800
0900
1000
100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
Time of day.

that this was a reflection of two factors which had changed. One was the increased availability of shotgun shells, because of the increase in income. The second was the decreased dependence of the natives on these birds as a source of food. Hunting was no longer just a way of obtaining meat, but it seemed to have taken on a slightly more recreational value.

Species Selectivity

Species selection by predators has been demonstrated in several studies. Mech (1966) states that while the Wolf (Canis lupus) is readily capable of killing moose, deer will bear the brunt of wolf predation when they are available. Estes and Goddard (1967) reported that African Wild Dogs (Lycaon pictus) concentrated their hunting efforts on one species of gazelle, which comprised 69 per cent of the food items of these animals. Cowan (1968) cites a case of species selection by the Cougar (Felis concolor) in Montana, when one of these large cats was observed to pass through a herd of Bighorn Sheep (Ovis canadensis) to attack an Elk (Cervus canadensis) .

The Slave Indians displayed similar selection for certain species of waterfowl. Species selection of waterfowl implies the ability to distinguish the various species of waterfowl in flight. It is not surprising that the Slaves are extremely proficient at this. Significantly they have names for all the species recognized by the whiteman. Table III presents species composition of waterfowl on East Hay Lake for the period August 21 to September 10 and the species composition in the harvest of waterfowl for the period August 18 to September 14.

TABLE III. Species composition in 1967 of waterfowl on East Hay Lake and in the kill by the Slave Indians.

Species	% of population	% of harvest
Mallard	46.8	46.6
Pintail	14.8	23.6
Am. Widgeon	4.4	12.7*
Shoveler	1.5	4.2
Lesser Scaup	---	0.3
Redhead	1.2	0.7
Blue-winged Teal	6.9	1.3*
Green-winged Teal	23.8	2.7*
Snow Goose	---	0.2
Canada Goose	---	1.0
White-fronted Goose	---	3.0
Gadwall	---	2.3
Canvasback	0.6	1.01
American Goldeneye	---	0.2
Bufflehead	---	0.2

*statistically significant difference for each species ($P. < .05$).

If selectivity is occurring, there should be a significantly different proportion of each species in the composition of the kill from that of the population. A Chi-square test of the comparative data for the six most abundant species of dabbling ducks demonstrated a highly significant difference ($P. < .01$). Therefore selection apparently was occurring. In order to show which species were being selected, a Chi-square test for homogeneity was performed. This showed that both species of teal were in significantly lower numbers ($P. < .05$) in the kill than in the population. Widgeons were present in significantly higher numbers in the harvest than in the population. This suggests an active selection for

Widgeon and against teal. Table III shows that there was a high selectivity for the larger dabbling ducks - Mallards, Pintails, Widgeons and against the teal. An unexpectedly high selection for Widgeons is partly a result of relatively higher vulnerability of this species to the hunters when compared to the Mallard and Pintail (Table IV). Another factor, which would result in an apparently lower percentage of Mallards and Pintails in the kill figures of Table III, is the fact that not all of the hunting was done on East Hay Lake where the population data were recorded. Some hunting was occurring on Southwest Slough at this time (Fig.6) and the species composition of this area was slightly different from that on East Hay Lake. From Appendices 4 and 5 it can be seen that both Mallards and Pintails formed a considerably smaller proportion of the population here than on East Hay Lake, while Widgeons were slightly more abundant. This would result in the kills from Southwest Slough being lower in the proportion of Mallards and Pintails and higher in Widgeons than the kill on East Hay Lake. The result would be to decrease the proportion of Mallards and Pintails and increase the proportion of Widgeons in the kill. Thus, the Slaves appeared to actively select certain species of waterfowl; the primary reason is an economic one, but cultural factors are also involved. A ranking of waterfowl in order of preference is shown in Table V. Insufficient data were obtained to determine the relative positions of the three species of geese, but they would undoubtedly be at the head of the list.

Figure 6. Graph of hunting activity and waterfowl abundance on Southwest Slough, 1967.

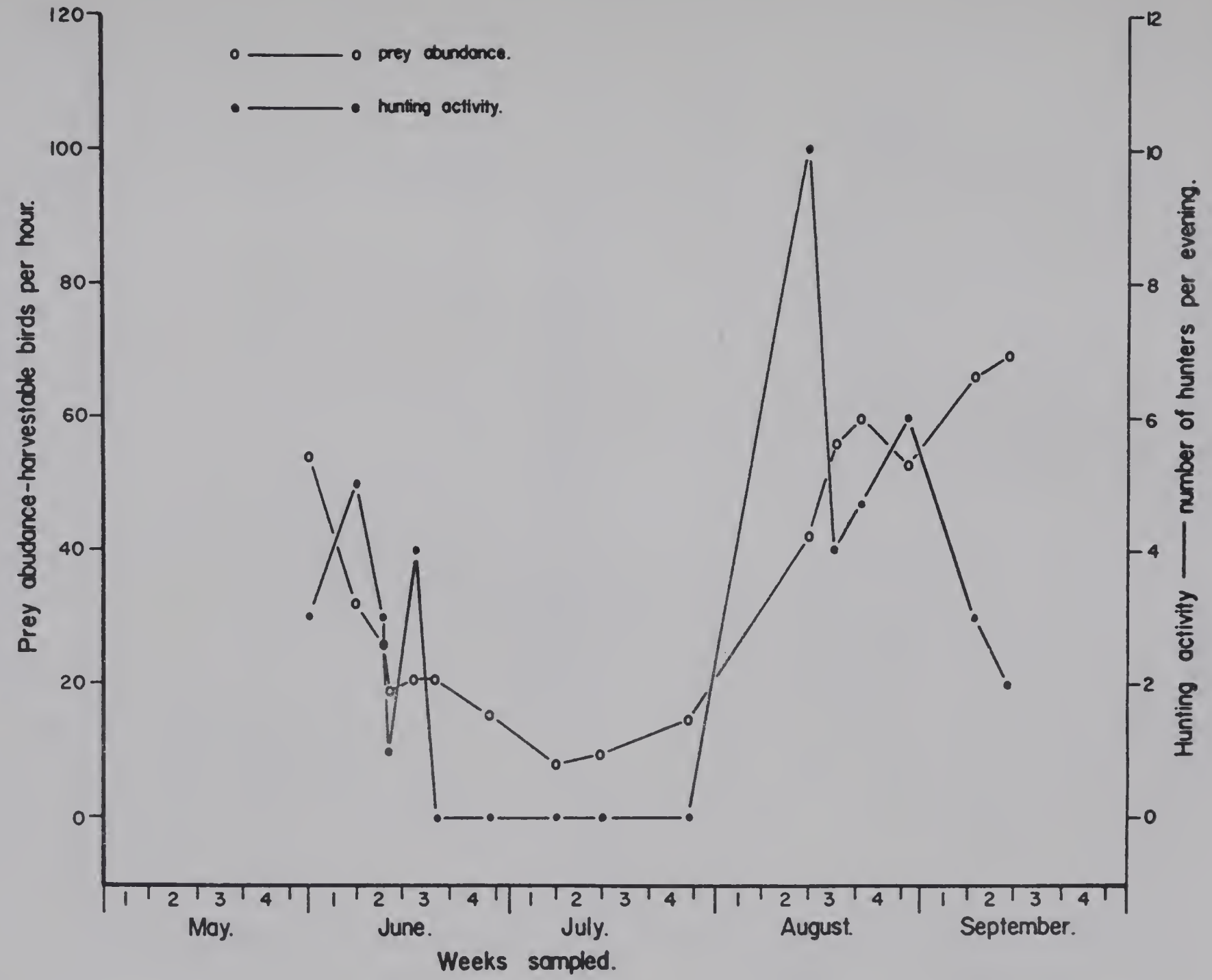

o ——— o prey abundance.
• ——— • hunting activity.
Prey abudance-harvestable birds per hour.
120
100
80
60
40
20
0
12
10
8
6
4
2
0
Hunting activity ——— number of hunters per evening.
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
May.
June.
July.
August.
September.
Weeks sampled.

Figure 7. Graph of hunting activity and waterfowl abundance on East Hay Lake, 1967.

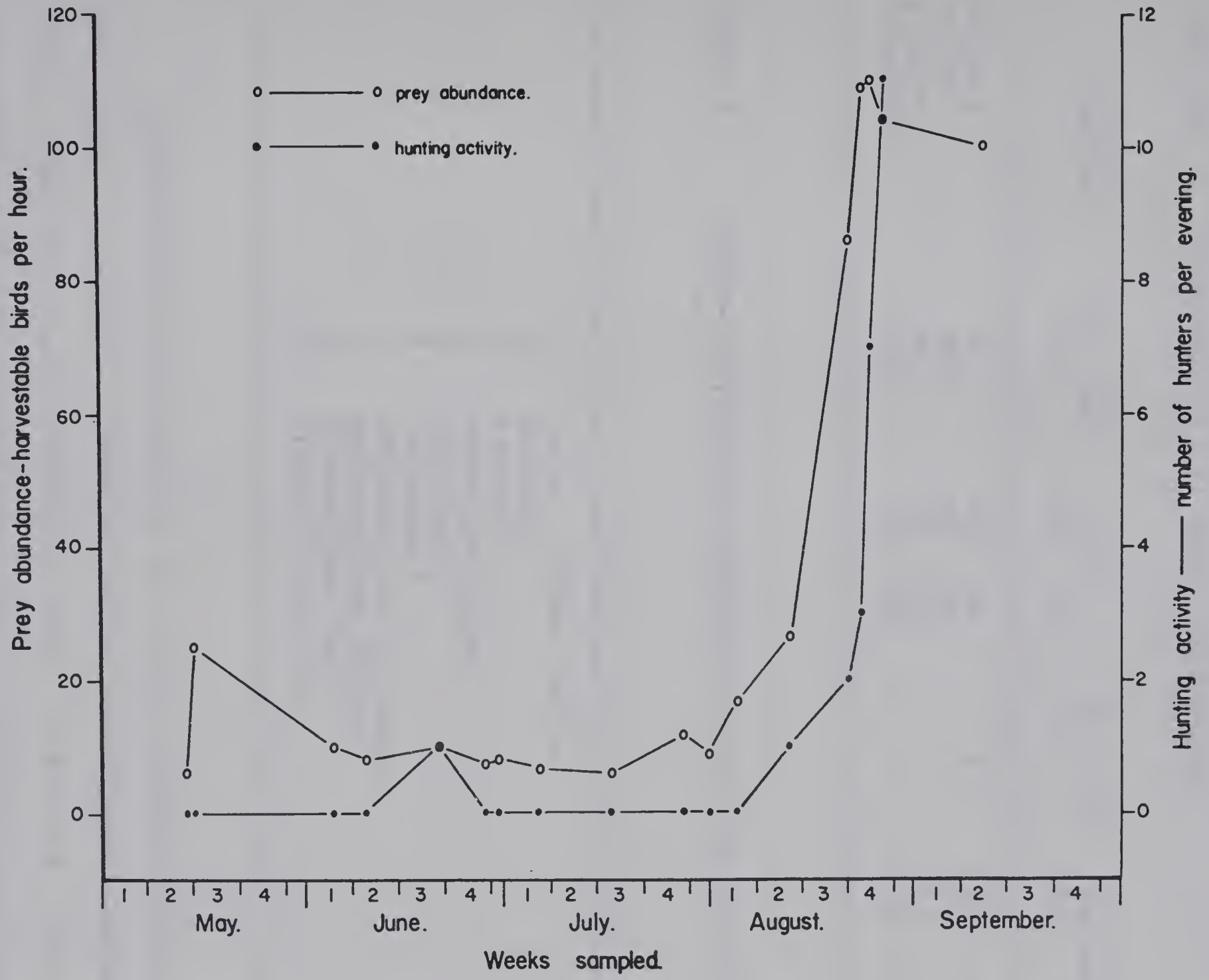

o ——— o prey abundance.
• ——— • hunting activity.
Prey abundance-harvestable birds per hour.
Hunting activity —— number of hunters per evening.
120
100
80
60
40
20
0
12
10
8
6
4
2
0
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
May.
June.
July.
August.
September.
Weeks sampled.

TABLE IV. Vulnerability of ducks to hunters.

Species	No. shot at	Hits No.	Hits %	No. lost	Recovered No.	Recovered %
Mallard	71	42	54	2	40	59
Pintail	46	26	57	-	26	57
Widgeon	64	42	66	-	42	66
Shoveler	28	16	57	-	16	57

TABLE V. Slaves' preference ranking of waterfowl species.

1.	Geese - three species
2.	Mallard
3.	Pintail
4.	American Widgeon
5.	Shoveler
6.	Canvasback
7.	Redhead, Lesser Scaup
8.	White-winged Scoter
9.	Blue-winged Teal
10.	Green-winged Teal

Although active selection for certain species appeared to be practised almost without exception by the adult hunters, amongst young boys just learning to hunt, it did not. Data were obtained on one or more hunts for 11 different men and boys, under the age of 18 years, and these data appear in Tables VI and VII. It is apparent from these tables that the high selection for the larger dabbling ducks which was

characteristic of the adult hunters, was not demonstrated by the boys. In addition, the rigid selection by the adults against teal was not practised by the young hunters. Appendices 1 and 2 give the detailed information for each hunter, and from the data, it can be seen that one young hunter did appear to be actively selecting certain birds. He also had slightly greater efficiency than his companions. I attribute these differences to the extra two years of shooting experience which this boy had obtained. These obervations would suggest that selection of certain species does not become an active factor in the hunting activities of the Slaves until a certain amount of experience and proficiency have been attained.

TABLE VI. Number of potential targets and per cent shot at by 11 different hunters (over 18 years of age).

Species	No. potential targets	% shot at
Mallard	188	96.5
Pintail	121	95.0
American Widgeon	132	98.5
Shoveler	93	84.0
Gadwall	3	100.0
Blue-winged Teal	183	2.7
Green-winged Teal	310	0.0
Lesser Scaup	19	36.8
Ring-necked Duck	1	0.0
American Goldeneye	4	0.0
Redhead	25	32.0
Canvasback	11	72.7

It was noted previously that the success of the younger hunters was much lower than that of the older men. Associated with this facet of the hunting activities of the boys were several other features which all suggest comparisons with the young of "natural" predators. There appears to be a series of training periods through which young boys progress before they are allowed to use a shotgun. The first introduction to hunting begins with the use of the slingshot, which most of the boys from eight to twelve years of age own. They become extremely proficient with this weapon and are quite capable of killing or wounding small birds. On several occasions they were observed to knock down warblers (Parulidae) and sparrows (Fringillidae). The way in which injured birds were mauled and played with was strikingly similar to the way in which a cat will play with a mouse. Another weapon which was used effectively to kill Longspurs (Calcarius lapponicus), Larks (Eremophila alpestris), and Pipits (Anthus spinoletta) was a straight stick about two feet long. When a flock of birds was seen on the ground, the boys would approach within about 20 yards, then flush the birds and throw the stick in such a manner that it spun through the dense flock, frequently knocking down two or three birds.

At about the age of 14 years, boys were allowed to use .22 rifles and .410 gauge shotguns, with which they tried to mimic their elders' hunting techniques. Generally by the age of 15 or 16, the boys were considered old enough to use a shotgun of 16 or 12 gauge.

TABLE VII. Number of potential targets and per cent shot at by 4 young hunters (under 18 years of age).

Species	No. potential targets	% shot at
Mallard	75	69.5
Pintail	16	94.0
American Widgeon	15	100.0
Shoveler	20	70.0
Gadwall	1	100.
Blue-winged Teal	36	36.2
Green-winged Teal	36	27.8
Lesser Scaup	14	35.7
American Goldeneye	4	75.0
Redhead	7	57.2
Canvasback	3	0/0

Thus, it appears that a training period during boyhood takes place for the purpose of teaching the potential hunters methods of hunting as well as obtaining knowledge of the natural history of their prey.

I think one might logically compare the activities of the younger boys with the play hunting and mock battles which Loizos (1966) describes as characteristic of many young predators. This form of play has been suggested to provide a means of learning and preparing for the activities of adult life. Schenkel (1966) describes the play of lion cubs

(Panthera leo) with inanimate objects, the cubs making mock attacks and 'defending' the 'kill'. The author describes the abortive attempts of yearling cubs to attack a variety of game, including such unorthodox behavior as attempting to dig out the dens of warthogs (Phacochoerus aethiopicus).

It is apparent then, that play activities related to hunting activities may well serve a useful function in the development of young predators, and until the hunting patterns of the adults are learned and perfected, a variety of techniques as well as a variety of prey, are tried.

Egg Gathering

Traditionally, waterfowl eggs were a substantial dietary supplement for the Slaves in summer. Several hunters related how women and children went out on egg-gathering expeditions in late spring. During the study period, however, no evidence of this activity was seen.

D. A. Boag (pers.comm.) suggested that this activity was still being carried on in 1965, as children in the village were observed playing with ducklings, presumably found in the course of nest-hunting and subsequently brought home as pets.

One incident was related to me by Boag which shows again the opportunistic aspects of the natives' hunting activities. One man was observed while in the field to flush a female duck from her nest. He lunged at the bird but missed. He then examined the nest and picked up one of the eggs and held it to his ear. He shook it, checking to see if it were fresh.

He told Boag that eggs were eaten frequently on hunting trips.

Klein (1967) stated that the Eskimo women and children of the Yukon-Kuskokwim delta organized co-operative egg-gathering expeditions. Among the Slaves, according to my informants, it was also mainly the women and children who gathered eggs in the marsh areas around Habay. Coot eggs were the most frequently obtained, probably because they have a large number of eggs in the nest, and the nests are relatively easy to find.

In recent years, egg-gathering has become a rather unimportant activity for the Slaves. The reason for discontinuing this practice is not clear, but it is presumably a result of declining breeding populations of waterfowl.

It may be that someone has informed the people that they should not molest nests, just as they were told that they should not shoot female ducks in the spring, "because they have eggs". Economic conditions are such that the Indians are now able to buy eggs from the local store when they want them.

Sex Selectivity

In 1966, one hunter was observed who appeared to actively select male ducks in preference to females when hunting birds in the spring plumage. When questioned about this, he replied that he did not shoot the females "because they have eggs". These observations were made on two hunts which took place on May 23 and 25, 1966, at which time many birds were still paired, and there was an equal opportunity in most instances, to shoot either or both birds of a pair when

they came within range. Table VIII gives the results of the May 25 hunt, 1966.

TABLE VIII. Sex selection by one hunter on May 25 hunt, 1966.

Species	No. pairs as potential targets	No. males shot	No. females shot.
Mallard	4	3	0
Pintail	3	3	1
Shoveler	6	4	0
Total	13 pairs	10	1

It can be seen from Table VIII that, although there were 13 instances where equal opportunities were available to shoot either sex of a pair, in only one case out of 10 kills was a female knocked down, and this was accidental, as both birds were killed with one shot. This was the only instance in which sex selection could be demonstrated, however. Comparable data for only two other hunters were obtained, and these men were indiscriminate in their choice of birds. During most of the open water season at Hay Lakes, the birds are in the eclipse plumage, making sex distinction by plumage virtually impossible. For these reasons, it appears that selectivity for sex is not an important feature of this people's hunting activities.

Age Selectivity

It appears that the same reasons for taking only the larger species of waterfowl are applied to juvenal birds as well. Numerous opportunities were available during the study period for hunters to shoot broods of ducklings, but on three occasions only were broods of young ducks, as well as the hen, shot. In all instances it was by the same hunter. From a total of 21 ducklings in three broods, 11 were killed plus the accompanying hens. The young were all of age class"2B", and the hunter expressed no concern over the survival of the remaining young, as he said they could fend for themselves.

The exception to this general rule occurred on the organized drives for flightless birds, in which the young were killed readily, presumably because there was no need to expend shotgun shells to kill them.

In view of the low percentage of young in the kills from these hunts and the rare occasions on which they were taken under other circumstances, the kill of flightless young would seem to be an insignificant portion of the total kill.

Prey Density and Intensity of Hunting Activity.

In 1966, it was noted that the intensity of hunting activity shifted with changing densities of prey or of particular prey species. Thus, it was observed that during early August, hunting intensity was highest at the mouth of North Creek (Fig. 1). The birds being shot were almost exclusively pintails, but when these were replaced by a large influx of shovelers, the

former hunting pressure,as high as 10 men per evening, was reduced to almost nil; there was a shift to the area termed Southwest Slough (Fig. 1), where both pintails and mallards were abundant. Hunting continued in the latter location for about two weeks until the arrival of the first large flocks of Canada and White-fronted Geese caused the hunters to begin hunting along the south shore of East Hay Lake.

In 1967, censuses of waterfowl and hunters were carried out systematically on these areas in an attempt to demonstrate quantitatively the relationship of prey density to hunting activity. The results are presented in Figures 4, 6 and 7. In Figure 6, it is apparent that prey density remained generally lower than in the other two areas, and except for one observation in late August, hunting activity here was zero for most of the summer and fall. The five-man hunting party observed here on August 24 was a group of men from a neighboring reserve. North Creek was chosen because it had been hunted in previous years by two of the men. One probable reason for the lack of hunting activity in late summer, even though the density of prey was comparatively high, was the greater proximity of equal or higher densities of prey on the other two areas (Figures 6 and 7). It appears from these latter data that, as the population of the prey decreases, a point is reached at which the "law of diminishing returns" becomes critical, and hunting ceases to be worthwhile. These data suggest that when the level of prey availability falls below an index of 20 harvestable birds per hour, hunting activity ceases; when it increases beyond this point again, hunting activity resumes.

The drop in hunting activity which occurred on Southwest Slough at the middle of August (Fig. 6) was complemented by a rise in the number of men hunting along the south shore of East Hay Lake (Fig. 7). The reasons for this were threefold: (1) the first flocks of geese were arriving and appeared to be using East Hay Lake almost exclusively; (2) availability of ducks was higher in this area; (3) band sponsored hay-cutting projects were occurring along East Hay Lake. The men involved were camped along the shore of the lake, making this area the most readily accessible.

Thus, it is apparent that hunting activity is dependent on availability of birds, the types of birds present, and the distance from camp.

Hunting Efficiency

The hunting efficiency, defined as the number of birds killed and recovered expressed as a percentage of the number of shots fired, varied in the two years of the study. It was considerably lower in 1967.

In 1966, the average number of shots fired on one-day hunts was 25. This came about from the practice of buying a box of shells before each hunting trip. The hunter would then shoot until he ran out of shells. An estimate of the average number of birds killed on one-day hunts for all the hunters throughout the season can be obtained from wing collections made. In 1966, the mean number of ducks shot per man per one-day hunt was 16.3. Assuming that each hunt represented the expenditure of 25 shells, the calculated efficiency would be 65 per cent.

In 1967, the efficiency was calculated in a similar manner. The mean number of pairs of wings turned in for one-day hunts was 16.0, while the number of shells fired on each hunt had increased to 31, based on the observations of 22 hunts (Table IX). Thus, it required 31 shells to obtain an average of 16.0 ducks per hunt, which gives an efficiency figure of 52 per cent. The hunting efficiency also can be obtained directly from field observations. In referring to Table IX, a slightly higher efficiency was recorded compared with the calculated figure. This may be due to a bias in sampling. The hunters considered in Table IX were chosen at random while in the field, so that the men who were hunting most frequently would form the largest proportion of the sample. These would most likely be the most efficient hunters, by virtue of the amount of practice obtained, and therefore not representative of all hunters.

The figures on efficiency, calculated from the wing collections, are believed to be overestimates. This could have arisen through an error in the recording of the number of hunting days represented in individual samples of wings. If a frequency polygon of the number of birds killed on one-day hunts in 1966 and 1967 is constructed, a bimodal distribution is suggested (Fig. 8). The mode of 11 to 12 birds per man per one-day hunt is followed by a second peak at 19 to 20 and a third at 31 to 32, suggesting that perhaps these are a result of two or three hunts being grouped together and reported as one.

Figure 8. Frequency polygon showing distribution of size of kill on individual, one-day waterfowl hunts.

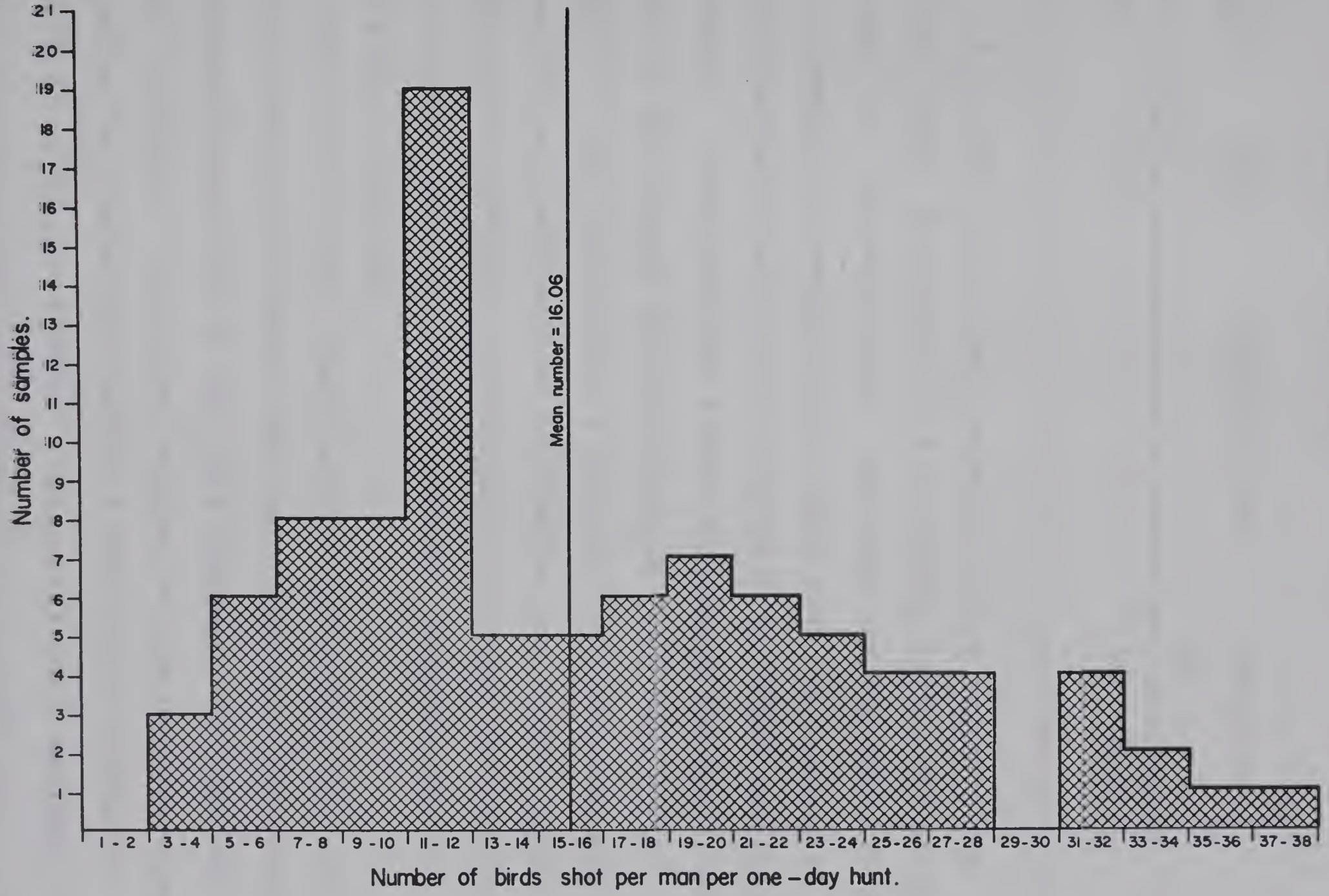

Number of samples.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
Mean number = 16.06
1 - 2
3 - 4
5 - 6
7 - 8
9 - 10
11 - 12
13 - 14
15-16
17 - 18
19 - 20
21 - 22
23 - 24
25-26
27-28
29-30
31 - 32
33 - 34
35-36
37 - 38
Number of birds shot per man per one – day hunt.

TABLE IX. Average efficiency of 11 hunters on 2 hunts per man, 1967.

No. shots fired	No. hit	Crippled & lost		Recovered	
		No.	%	No.	%
687	391	9	2.2	382	55.6

If we consider the mode as more closely representing the actual number of birds killed on one-day hunts, the calculated efficiency for 1966 would be 46.1 per cent and for 1967, 37.2 per cent. Thompson and Person (1963) found that the success of the Point Barrow Eskimos in killing eiders in flight was about 30 per cent. The calculated higher efficiency for the Slaves probably is due to more favorable hunting conditions which resulted in a very low crippling loss of 2 per cent compared with over 40 per cent reported by Thompson and Person (Ibid.) The high winds and ocean currents associated with the hunting area at Barrow would undoubtedly increase crippling losses, as the authors point out.

Regardless of the actual per cent efficiency, the relative values of 1966 and 1967 remain the same, reflecting the changing role played by waterfowl in the Slave economy. The improved economic situation at Hay Lakes resulted in a decreased dependence on waterfowl as a necessary source of food and an increased availability of shotgun shells. The result was a decrease in hunting efficiency, which was accompanied by a much less serious attitude towards the killing of birds. In short, the Slaves

hunting activities had taken on a greater recreational value. Thompson and Person (Ibid.) noted a change in hunting techniques and attitude towards waterfowl hunting when the cash incomes from oil exploration companies ceased. The Eskimos decreased the number of shells expended by choosing densely-bunched flocks of birds, into which they discharged both barrels of their shotguns simultaneously. The result was an approximate doubling of the kill and tripling of crippling losses. This seems to be the converse of what occurred at Hay Lakes.

Use Made of Waterfowl Harvested

The pattern of utilization of waterfowl appears to be very consistent among all the families at Habay. Without exception, the meat is consumed in a fresh condition. No evidence of smoking or drying the meat for future use was recorded. Any birds in excess of what a hunter's family could consume before the meat spoiled were distributed to families which, for one reason or another, did not contain hunters. This community concept of sharing the proceeds of the hunt with members of the group who were unable to obtain their own food has been described for other predators (Estes and Goddard, 1963). African wild dogs were observed to share their food with disabled animals or females with pups.

The carcasses of birds killed are plucked of most of the feathers, the wings are severed at the distal joints of the humeri, and the heads cut off midway along the neck. The remaining feathers and down are singed off by letting the carcass hang

over a fire momentarily. The entrails are then removed and the carcass butchered in one of two ways, depending upon whether the meat is to be roasted or boiled. If it is to be boiled, the major muscle masses, such as the pectoralis muscles and the legs, are cut off and the pieces placed in a pot to boil for a variable length of time, generally 1 to 2 hours. The meat is then eaten from the bones, and the bones are used as dog food. The entrails, wings and head are also used as dog food.

If the carcass is to be roasted, which is usually the case when in the field, the sternum is removed after the bird is eviscerated. This is accomplished by cutting away the breast muscle and skin on either side of the keel, breaking the coracoid bones, and severing the ribs. The pectoralis minor muscles are usually left attached to the sternum, and this is placed at the edge of the fire to cook. The remainder of the carcass, which includes the breast and wing muscles, the back, and the entire legs, forms a flat sheet of more-or-less even thickness, held together by the skin. It is next skewered on a stick pointed at both ends, the stick passing through the skin and breast muscle on one side, between the skin and spinal column, and continuing through the breast muscle and skin on the other side. The opposite end of the stick is then pushed into the earth, with the carcass held over the fire. Thorough cooking of the meat is thus obtained by virtue of its consistent thickness.

On the basis of the former method of preparation, it was determined that approximately 60 per cent of the total weight of a duck is available as human food. This figure was arrived at by weighing a series of whole carcasses, then weighing

again after evisceration, plucking, and removal of head and wings. The carcasses were then boiled so that the bones could be scraped free of flesh. The weight of the bones was taken, and this was subtracted from the weight of the eviscerated carcass, giving the amount of meat removed. This latter weight was then expressed as a per cent of total body weight.

In many instances, even the feathers were saved to be utilized in the manufacture of quilts and sleeping robes, so it is apparent that little wastage occurs. Further, despite the fact that no attempt is made to preserve the meat, no instances were recorded of spoilage. This lack of wastage is common to other predator populations as well. Mech (1966) points out the extensive use made of moose kills by wolves.

The presence of dogs in the village is reminiscent of the relationship between a predator and the scavengers which follow it in search of "leftovers". Estes and Goddard (1967) describe such a situation with the African wild dogs, which had numerous "hangers-on". The situation is not strictly analagous however, for the relationship between the Indians and their dogs is a mutualistic one, while that of the predator and its scavengers is essentially a form of commensalism.

Other Birds

The known harvest of upland game birds during the study period consisted of 12 Ruffed Grouse (*Bonasa umbellus*) in 1966 and 5 Ruffed and 1 Spruce Grouse (*Canachites canadensis*) in 1967.

The wings from these birds were collected along with the duck wings. I suspect that the harvest was somewhat higher than this, however, since "chickens" are considered to be a delicacy and a welcome change in diet from duck. Presumably some were shot and eaten on hunting trips or trapping expeditions and not reported to me.

I believe that during the fall and winter the harvest of grouse and Ptarmigan (Lagopus lagopus) which winter in the Hay Lakes region, would increase. Conversations with several Habay residents in November of 1967 suggested that numerous "chickens" had been killed that fall. The total number of grouse killed was probably insignificant because the population was so low during the period of this study. In years of peak abundance, however, they probably constitute a major alternate prey species.

Sandhill Cranes (Grus canadensis), although present in the area, were seldom molested; only one instance was recorded of a crane being shot.

Isolated observations were made of Crows, (Corvus brachyrhynchos), gulls (Larus spp.), and a Shorteared Owl (Asio flammeus) being shot, but these were insignificant in number and attibutable to "trigger-happy" boys, or, in the case of the owl, a disgruntled hunter who had failed in an attempt to stalk a large flock of feeding geese. This is an excellent example of displacement behavior.

Large Mammals

In the 1966 study period, a total of four Black Bears and three moose were shot by Habay residents. Of the four bears, one was an adult female, killed with her twin cubs, the fourth an adult male. The moose killed were a cow and her calf and a yearling bull. In 1967, only two moose were taken, the sex of neither one being discovered.

Both bear and moose meat are highly prized food items, many people preferring bear, again "because they are fat".

From the few observations made, apparently no sex or age selection occurs in the taking of large mammals. Helm (1961) similarly observed that the Slave Indians on the Mackenzie River were not selective for the age or sex of large game mammals.

The Slaves most commonly killed moose or bear along the rivers, in which the animals sought relief from biting insects during the summer. Frequently, however, organized hunts consisting of four or five men were arranged. They went on horseback or with a team and wagon to areas of known moose and bear habitat. A camp would be established from which the men spread out to hunt individually, usually returning to the main camp at night. Such a hunt would usually last until one or more animals was killed or the supply of food was depleted. When an animal was killed, it was gutted immediately, with the lungs, heart, liver, and kidneys being saved. These, as well as the meat, hide, and head, were transported back to the village, where the successful hunter shared a portion of the meat with his less fortunate companions and with his relatives. As much

meat as possible is eaten fresh, either boiled or roasted, the excess being cut into thin sheets and smoke-dried in the sun for three to five days.

The hide is fleshed, then smoke-dried over a poplar fire. If leather is to be made the hair is scraped off. Reportedly a mixture of brains and bone marrow is then rubbed into the hide. Scraping and working the hide continues until it becomes soft and pliable. It is then washed, dried, and relaxed again. The final step is to smoke the raw hide over a smouldering fire of rotten spruce chips. This is said to prevent the leather from hardening after it has become wet.

The finished product, in the case of moosehide leather is used for moccasins, mukluks, decorative gloves and vests, and also for ceremonial drums.

The hair is usually left on when tanning bear hides, but otherwise the process is the same. Bear hide is used for sleeping robes and for decorative trim on mukluks and leather slippers.

To complete the list of utilized parts, the fat of bears is rendered to make lard, and the long bones of moose and bear are cracked open for the marrow. Thus, it can be seen that extensive use is made of a kill, but unlike natural predators which utilize only the edible parts of an animal, the Slaves go beyond this and employ many of the non-edible side-products in a cultural context.

Small Mammals

The only small mammals utilized to any extent during this study were the furbearers. Utilization of these mammals during the summer was not extensive, since the trapping season ends about the middle of May. For the purpose of this study, essentially all of the income from the winter trapping season had been obtained prior to my arrival, save for a small number of beaver pelts which were left from earlier sales. The estimated income for the entire village from this source during my presence was about $200.00.

The only furbearing animals which seemed to be used for food were beavers; only two instances of beavers being killed for food during the summer were observed. Both of these were chance encounters with the animals along the river while the hunters were hunting ducks from canoes. On numerous other occasions, ample opportunity was available to kill beavers, but the hunters merely regarded them with interest, allowing the animals to pass unmolested.

According to the natives, snowshoe hares are killed for food when they are available. Evidence was also found at an abandoned cabin that the skins of these animals may have been used to make sleeping robes, as the remains of such an article were found. At the present time, however, no such use seems to be made of these animals. During the study period, hares were extemely rare, and no data were obtained on utilization.

Traditionally, trapping has been a major winter activity of the Slave Indians, and it is still a source of pride for a man to have the reputation of being a good trapper. In recent years, the possession of a registered trapline has similarly become a status symbol. These two factors appear to be the chief motivating force for the few men who continue to trap during the winter. From conversations with the trappers and with Mr. John Love, it is apparent that trapping has become an inefficient source of income, and in fact, the incomes obtained from this source barely pay for the expenses incurred. Thus it appears that tradition and the culturally imposed values associated with trapping are the main factors perpetuating this activity. Because the young men of the community do not appear to share this attitude of the older generation, very few of them have learned to trap, and it seems highly likely that the practice will die with the older generation.

Fish

Fish were taken with gill nets and by hook and line. In 1966 most of the fishing was done with gill nets. These were 3 1/4 inch mesh nylon nets, which were set in midsummer when the fish had moved out of the lakes into the river. There were two basic ways that the Slaves set their nets. The commonest way was to fasten a 25-yard length of net, with floats on top and weights on the bottom, between two long poles driven into the river bottom. The net was usually about four feet deep and

Would be set just below the surface. The other type used throughout the open-water season, is a shorter net, but instead of being anchored between two poles, is simply fastened to a 15-foot green sapling floating on the surface. It is placed perpendicularly to the bank and guyed in place with ropes. This type of net had the advantage that it could be checked from the shore.

Ninety-seven observations of nets lifted in 1966 revealed a mean number of 2.3 fish per net per day, 94 per cent of which were Pike and 6 per cent Walleye. No suckers (Catostomus sp.) were observed in nets; however, the remains of three of these fish were found at two different campsites. No figures on total harvest of fish were obtained in 1966.

In 1967, the method of fishing changed to the use of handlines. Nets were not used as extensively nor over such a duration of time as in 1966 (Tables X and XI).

The average catch per net per day in 1967 was 0.9, considerably less than for the comparable period in 1966, when an average of 2.3 fish were caught per net per day. This would suggest that the availability of fish in the region where the nets were set, on the upstream side of the village, was not high enough in 1967 to warrant checking them and cleaning out the debris daily. Coincident with this situation was the high concentration of fish at the junction of the Hay and Amber Rivers. I believe that the shift to handlines occurred because the distance from the village to this area of fish abundance was too great to travel two or three times each day to empty the nets.

TABLE X. Daily fish catches in nets set in Hay River, May 23 to Sept.11, 1966

Date	No.of nets set	Average No. fish/net/day
May 23	4	1.5
May 27	3	2.3
June 6	1	1.0
June 17	2	2.0
June 26	3	2.7
July 3	2	1.5
July 15	4	3.2
August 6	6	5.5
August 10	8	4.8
August 14	11	3.6
August 24	12	3.1
August 31	10	2.9
September 5	2	0
September 11	1	0

Rather, the people chose to make the trip when they had time to spend several hours fishing. If the men had not been steadily employed at this time, I think that a fishing camp would have been established here for several days at a time. However, the men were not available to do this. Another possible reason for this shift to a seemingly less productive means of fishing might

be related to the increased incomes of the natives in 1967. There would not be the urgent need to catch fish for dog food because there was sufficient money to buy it at the local store. Fishing, then, may have taken on greater recreational importance, thus the use of handlines instead of nets. Table XII shows the number of hours spent fishing at the junction of the Hay and Amber Rivers. It is apparent that the time spent fishing was at most six hours, usually 1500 to 2100 hours. It would seem that if this were a serious effort to obtain a supply of fish, greater periods of time would be spent fishing. This is the length of time one would expect to be spent if fishing were only a diversion or recreational activity.

An approximate measure of the number of pounds of fish taken during the summer of 1967 can be obtained by multiplying the number of fish in each size class (Table XII) by the midpoint of that size class and summing these figures. These calculations give a total of 5,366 pounds of fish taken by Habay residents during the summer on handlines. When the total number of fish caught in the nets at Habay are added to these figures, assuming an average weight of four pounds a summer harvest of 5,470 pounds of fish is obtained.

In all instances when fishermen were asked what use would be made of the fish, the reply was that it was to be used as dog food. In preparing the carcasses for drying, heads and entrails were removed and discarded. The body was split the length of the spine, leaving the two halves joined only by the skin at the tail. The carcass could then be draped over drying racks above

TABLE XI. Daily fish catches in nets in Hay River, May 28 to June 19, 1967

Date	No. of nets set	Average No. fish/net/day
May 28	1	0
June 1	2	1.5
June 2	2	3.0
June 3	2	2.0
June 5	2	0.5
June 9	4	0.75
June 15	4	1.25
June 16	3	1.3
June 18	1	0
June 19	1	0

the fire. Dogs were fed this dried meat by cutting the skin at the tail region, each dog receiving half of a four-pound fish every day in winter, but only every two days in summer when they are inactive. This diet was supplemented with dog meal purchased from the local store. It was prepared by boiling with water to form a mash; each dog received about one pound of this food per day when no other food was being given.

Similar techniques for the preservation of fish are described by Helm (1961), and it appears that the use made of fish by the Slaves of the Upper Mackenzie was of a similar nature

TABLE XII. Harvest from Hay River by fishermen using hook and line, July 21 to August 3, 1967

Date	No. of fishermen	Size class I	II	III	Hours spent	Freq. of catches (No.fish/hr 'man)
July 21	2	9	-	-	-	-
July 25	5	193	8	5	-	-
July 26	9	112	46	2	-	-
July 27	8	43	4	1	-	-
July 28	2	61	11	2	3	12
" "	2	39	4	3	3	7.2
" "	2	3	-	-	1	1.5
" "	1	3	-	-	2	2.0
" 30	2	12	5	-	1	8.5
" "	1	25	15	-	1.5	20.7
" "	1	2	4	-	-	-
" "	1	8	2	-	1	10.0
" "	7	12	8	-	5.7	0.5
August 1	7	112	27	-	-	-
August 2	17	179	3	-	-	-
August 3	2	11	-	-	-	-
August 4	9	91	-	-	-	-
Totals		915	137	13		

to that of the Hay Lakes people, that is, primarily as a source of dog food. Its use as human food was restricted to periods of scarcity of all other types of food.

In contrast to natural predator populations, the Slaves utilize one form of natural resource not as a source of food for themselves, but for dogs which are an essential element of their way of life. This is an example of an instance in which hunting activities are a direct demand of the culture, a uniquely human situation.

Plants

Plant utilization by the Slave Indians at Habay is not extensive. The only plants utilized as food were several species of berries, a species of mint, and an unknown marsh plant, the root of which is dried and used as a medicine called "rat root". It is believed by its users to be an effective cure for the common cold and influenza. Its use is thought to be of Cree origin, as it is mainly the Cree families which use it. I was unable to obtain specimens of the plant, as my informant would become evasive and unwilling to talk when questioned about the origin of the root.

The fruit of the wild rose (Rosa sp.) was probably the most heavily utilized plant food. During the summer when the rose "hips" are ripe, all the children had their pockets bulging with this fruit. The fleshy portion was eaten, the seeds being discarded. Occasionally this fruit was boiled and eaten like stewed prunes. However, there did not appear to be

any attempt to pick this fruit specifically. In late summer when the saskatoons (Amelanchier alnifolia)and chokecherries (Prunus virgianus) are ripe, groups of women and children go out for the express purpose of picking them. Chokecherries are harvested more extensively, as they are commoner and more easily picked. Although data are scant and incomplete, the annual harvest of edible fruits is estimated at about 300 pounds.

Several families were observed to gather mint (Mentha sp.) during the summer. This they dry and use to flavor their tea.

In the past, one of the main modes of transportation was by canoes constructed from spruce bark. In 1966, several such canoes were in evidence, but during 1967, none were seen.

The aboriginal craft was constructed from a 12 foot strip of bark which had been carefully peeled from a large spruce (Picea glauca). While still moist, the bark was bent, rough side inwards, around a form made of small willows which were bent in the form of ribs. Gunwales were made from split willow (Salix sp.) or spruce rails, and these were used to sandwich the ribs and the bark between them. These were then lashed together with spruce roots. The ends were similarly lashed, then caulked with spruce pitch. All knotholes were plugged with pitch to waterproof the craft. "Floorboards" made of spruce bark were then laid on the bottom to protect the covering and ribs. Paddles were hand-hewn from spruce, usually in the shape of conventional paddles. The finished craft was about 11 feet long, 20 inches at the beam, and 12 inches deep.

It appears that these craft are a thing of the past, as most of the old craftsmen have died and the techniques of construction have not been passed on to the younger men.

Another product of the traditional Slave culture which utilized plant resources was the birchbark basket. Originally, it was used as a container for a variety of objects, as well as a vessel in which water was carried and heated by placing heated rocks in the container of water. Unlike the spruce-bark canoe, however, its maufacture has been preserved chiefly as a saleable item in the handicraft trade. It is made in a variety of sizes and is constructed from a single piece of birch bark cut to a precise pattern and sewed together with split roots of spruce or willow. The manufacture of these baskets is carried on by one old woman living at Assumption, who earns an estimated $250 per year from the sale of these baskets. Thus, their manufacture is not extensive, and it would not constitute a major utilization of the available resources.

The greatest use made of plant material by the Slaves is for firewood. This is the only source of fuel for cooking and heating. Poplar (Populus sp.) appeared to be the most extensively used wood for these purposes. Gathering firewood is one of the major daily tasks of the women, but it is becoming increasingly difficult to find near the village. It is now necessary for the men to go out with wagons or trucks periodically to cut and haul a fresh supply of dry wood back to the settlement. The construction of summer teepees, requiring twenty to thirty green poplar trees each,

also represents a significant use of plant resources.

It is apparent that the Slaves use an insignificant amount of the plant resources of the area as a source of food, but much greater demands are made on these resources to meet the cultural needs of the people.

CONCLUSIONS

The Slave Indians at Habay utilize waterfowl for food more extensively than any other natural resource. In their waterfowl hunting activities they display many characteristics common to natural predators.

The hunting techniques are standardized amongst the Slaves with slight differences in the amount of effort exerted between duck and goose hunting. This appears to be a reflection of the greater return in terms of meat available from a goose carcass, as well as the prestige value attached to killing a goose, which are culturally imposed factors. There appears to be a response on the part of the hunters to changing waterfowl populations. One component of this response is numerical, as shown by the practice of concentrating in areas of high prey abundance. The second component is a functional one; the numbers of prey taken decreased during the second year of the study, when waterfowl densities were lower and there had been an increase in income. This latter response is analagous to other predators redirecting their hunting activities towards secondary prey species when the numbers of primary prey decline.

A high degree of selectivity is also associated with the hunting activities of the Slaves. Species selection was actively practised by the experienced hunters. The prey species selected were the larger birds, with geese and large dabbling ducks being preferred. This again is due to economic factors, "getting the most for one's money", as well as to attitudes which were culturally imposed. Age selectivity was practised to some extent, presumably for similar reasons. Sex selectivity apparently occurred in isolated instances, but was not a prevalent feature of the hunting activities.

Daily hunting activity coincided with periods of peak prey activity, presumably for reasons of greatest efficiency.

There was considerable variation in hunting efficiency, both for individuals on different hunts and among different hunters. This is probably attributable to variation in natural ability, to the amount of practice obtained, as well as to daily differences in hunting conditions.

A generally lower efficiency was associated with young, inexperienced hunters. This, as well as the play hunting activities of boys suggests that there is a training period through which the potential hunters progress. Presumably this serves the function of teaching the young hunter the natural history of prey species as well as providing basic techniques for hunting activities of adulthood.

In their daily life, and especially while on hunting trips, the Slaves display opportunistic behavior which is common to other predators.

Once obtained, the prey is utilized extemely efficiently. Those portions of a carcass which are not used as human food are either fed to the dogs or employed in some cultural context, such as the manufacture of footwear from moosehide or of quilts from duck feathers.

The presence of dogs suggests a predator-scavenger relationship similar to that described for other predator populations. One major difference exists in this relationship, however; here the dogs have a direct beneficial effect on the predator, since they are used as a means of transport, and sometimes as an aid in hunting.

On the basis of these conclusions, I think it can be seen that the Slaves do show many attributes of a natural predator population.

Errington (1946) made the suggestion that there is an 'evolution' of the struggle for existence in vertebrate predator populations:

> "The writer believes that in the case of mammals the primitive form (of the struggle for existence) consists in a struggle with a shortage of food, which afterwards becomes a struggle against predators and epizooities, being transformed with an increase of immunity and the vigor of individuals into an intraspecific competition."

I think parallels can be seen between Errington's concept of an'evolving' struggle for existence in predator populations and the history of the Slaves. Aboriginally, the Slaves' main problem was one of obtaining sufficient food with

the primitive weapons available. This necessitated individual family groups spreading out over the entire "territory" of the band (c.f. Eisely, 1955 p.2). That this actually happened is suggested by the fact that numerous abandoned cabins were found scattered along Hay River. With the arrival of the whiteman, however, obtaining food became much less of a problem, since the whiteman introduced the natives to firearms, which greatly increased their food gathering efficiency.

With this problem eliminated, people were able to live in larger groups, which could be sustained through increased hunting efficiency. The whiteman brought not only weapons, however, but also introduced European diseases to which the Indians were extremely susceptible. With the movement of families into close proximity to one another, disease such as influenza and tuberculosis could, once introduced, spread rapidly to reach epidemic proportions. Such occurred with the Hay Lake people during the mid-1930's. Informants estimated that over half of the population died from an epidemic of influenza at this time.

As a result of increasing natural immunity and the establishment of a nursing station at Habay, the effects of these diseases were minimized, and now the Slaves appear to be entering the third stage of the 'evolutionary' process. Contact with white civilization and the necessary adjustments in the traditional culture which have occurred have resulted in a gradual breakdown of the "old ways". The traditional ideas

and moral values, which were satisfactory for the aboriginal way of life, but unsuitable for existence in the modern world, have been cast aside and no suitable replacements have been found. The results are seen in social disruptions which were apparent during the study period; the misuse of liquor and the inevitable syndrome of social ailments which follow have become a part of the life of the Hay Lake people. Socio-religious functions, such as "tea dances", have almost ceased to exist due to the inevitable fights which accompany them. The break-down of the traditional moral code has resulted in endemic levels of venereal disease and a substantial number of illegitimate births each year. The lack of unity and organization in matters of community concern, despite the efforts of the Indian Affairs Branch, is directly related to the absence of a strong, trustworthy leader who can command the loyalty of the elder, more conservative members of the band, as well as the younger, more liberal and progressive people.

Waterfowl Management and the Slave Indians

The apparent importance of the Hay and Zama Lakes complex to waterfowl suggests that a management program for the area should be initiated in order to allow maximum utilization by ducks and geese. I feel, however, that any management efforts must take into consideration the dependence of the Hay Lake people on this resource.

The increased opportunity for wage employment in the past four years has decreased the Indians' need for

waterfowl as a source of meat during the summer; they are financially capable, at the present time, of buying a good deal of their meat from commercial outlets. Prices are high, however, partly as a result of the isolated nature of the community, and partly as a result of the lack of competition among the retail outlets. Thus, while prices are high and wages are still lower than in most communities, there is a need among the Hay Lakes people to be able to draw on the natural resources, particularly waterfowl as a supplementary food source.

It is not foreseeable that wages will increase greatly in the near future; in fact, once the oil "boom" has passed, it is likely that economic conditions will deteriorate. Such a situation is described for the Point Barrow Eskimos by Thompson and Person (1963). If this situation occurs at Hay Lakes, the people should have the opportunity to draw upon the waterfowl resource again as a source of food.

According to present federal legislation in Canada, Indians are not allowed to hunt migratory birds outside the prescribed open seasons, except within the confines of the Indian reserves. This decision was upheld in a recent test case in the Northwest Territories (Regina vs.Michael Sikyea, Supreme Court of Appeal, N.W.T.) The problem of Indians being allowed unlimited hunting access to waterfowl populations is a difficult one, but each case must be judged on its own merits. The factors to be considered in making a decision pro or con are simple and easily defined. Initially, it is necessary to determine whether or not there is valid justification for allowing the

natives to hunt waterfowl outside the framework of existing game regulations. If the peoples' economic condition is sufficiently low that this would be the only form of meat available, then it is necessary to determine the status of the local waterfowl population and ensure that the Indians' hunting activities would not seriously deplete the population. Thus, if a waterfowl population were composed mainly of moulting male birds during the summer, which I believe to be the case at Hay Lake, then even rather extensive harvesting would probably not affect the continental waterfowl populations. On the other hand, heavy depredation on a major breeding ground could prove a serious drain on the populations involved.

It would seem justifiable to permit unlimited use of waterfowl by natives as long as the populations of birds were not being depleted and the birds harvested were not being wasted. It is rather difficult to condone hunting of birds purely for sport, while denying, or at least restricting, hunting activities of people who actually require this resource for a source of food, particularly when much more extensive use is made of the birds harvested by the Indians.

In conclusion, then, I feel that a waterfowl management program for the Hay Lake region or any other area with native residents must take into consideration the effects that such a program will have on the residents who may be depending on this resource as a source of food.

LITERATURE CITED

Carney, S.M. 1964. Preliminary Keys to Waterfowl Age and Sex by Means of Wing Plumage. U.S. Bureau Sport Fisheries and Wildlife. Special Sci. Rep., No. 82.

Cowan, I.McT. 1968. Summit Predators. Paper presented to Dept. of Zool., Univ. of Alta.

Driver, H.E. 1961. Indians of North America. University of Chicago Press, Chicago. 450 pp.

Eiseley, L.C. 1955. The Paleo-Indians:Their Survival and Diffusion. Bobbs-Merrill Reprint Series in the Social Sciences, A 58.

Errington, P.L. 1946. Predation and vertebrate populations. Quart. Rev. Biol., 21:144-177.

_____. 1967. Of Predation and Life. Iowa State University Press, Ames, Iowa. 277pp.

Estes, R.D. and J. Goddard. 1967. Prey selection and hunting behavior of the African Wild Dog. J. Wildl. Mgmt., 31:52-70.

Gause, G.F. 1935. The Struggle for Existence. Williams and Wilkins, Baltimore. 263pp.

Helm, J. 1961. The Lynx Point People: The Dynamics of a Northern Athapaskan Band. Natl. Mus. Can. Bull., No. 176.

Holling, C.S. 1959. The components of predation as revealed by a study of small mammal predation of the European sawfly. Can. Entomol., 91:293-320.

Honigmann, J.J. 1963. Understanding Culture. Harper and Row, New York. 468pp.

Huffaker, C.B. 1958. Experimental studies on predation: dispersion factors and predator-prey oscillations. Hilgardia, 27:343-383.

Klein, D.R. 1966. Waterfowl in the economy of the Eskimos on the Yukon-Kuskokwim Delta, Alaska. Arctic, 19:319-336.

Loizos, C. 1966. Play in mammals. In Jewell, P.A. and C. Loizos (eds.). Play, Exploration and Territoriality in Mammals. Academic Press, London. 280pp.

Mech, L.D. 1966. The Wolves of Isle Royale. Fauna Natl. Parks of U.S., Fauna Series 7. 210pp.

Odum, E.P. 1959. Fundamentals of Ecology. W.B. Saunders Co., Phila. 546pp.

Schenkel, R. 1966. Play, exploration and territoriality in the wild lion. In Jewell. P.A. and C.Loizos (eds.). Play, Exploration and Territoriality in Mammals. Academic Press, London. 280pp.

Smith, R.L. 1966. Ecology and Field Biology. Harper and Row, New York. 686pp.

Thompson, D.Q. and R.A. Person. 1963. The eider pass at Point Barrow, Alaska. J. Wildl. Mgmt., 27:348-356.

Tinbergen, L. 1960. The natural control of insects in pine woods: I. Factors influencing the intensity of predation by songbirds. Arch Neerl. Zool., 13:265-243.

Wissler, C. 1966. Indians of the United States. Doubleday and Co., New York. 336pp.

APPENDIX 1. Number of potential targets, number fired at, and success of 11 adult hunters (over 18 years) on 19 hunts.

Hunter	potential targets. a. shot at b	Mallard	Pintail	Am.Widgeon	Shoveler	Gadwall	Blue Winged Teal	Green Winged Teal	Lesser Scaup	Ringnecked Duck	Goldeneye	Redhead	Canvasback	% Success	Number of hunts
1	..... a	12	5	8	8	2	14	23	2	1	1	4	2		
	b	12	5	8	5	2	0	0	1	1	0	3	2	51.5	1
2	..... a	26	16	9	19	0	29	31	0	0	0	1	0		
	b	26	14	9	19	0	2	0	0	0	0	0	0	58.5	2
3	..... a	9	16	11	5	0	43	41	1	0	0	4	1		
	b	9	14	10	5	0	0	0	0	0	0	4	0	45.2	1
4	..... a	21	12	24	3	0	22	40	6	0	2	6	0		
	b	20	10	24	3	0	0	0	0	0	0	0	0	52.6	1
5	..... a	4	2	27	6	1	5	14	0	0	0	2	2		
	b	4	2	6	3	1	0	0	0	0	0	1	2	68.5	1
6	..... a	36	28	32	16	0	41	62	5	0	0	4	2		
	b	32	28	32	16	0	2	0	4	0	0	0	2	62	4
7	..... a	19	11	24	24	0	12	16	2	0	0	1	0		
	b	19	11	24	16	0	0	0	0	0	0	0	0	53	3
8	..... a	23	20	5	2	0	22	46	0	0	0	0	0		
	b	23	20	5	1	0	0	0	0	0	0	0	0	57.2	2
9	..... a	12	2	4	3	0	0	14	0	0	0	1	2		
	b	12	2	4	3	0	0	0	0	0	0	0	1	59.1	1
10	..... a	6	1	2	1	0	5	9	2	0	0	1	2		
	b	5	1	2	1	0	0	0	2	0	0	0	1	66.7	1
11	..... a	20	8	6	6	0	8	14	1	0	1	1	0		
	b	19	8	6	6	0	1	0	0	0	0	0	0	37.6	2
Total	a	188	121	132	93	3	183	310	19	1	4	25	11		
	b	181	115	130	78	3	5	0	7	0	0	8	8		

APPENDIX 2. Number of potential targets, number fired at, and success of 4 young hunters (under 18 years) on five hunts.

Hunter	potential targets - a, shot at - b		Mallard	Pintail	Am. Widgeon	Shoveler	Gadwall	Blue-Winged Teal	Green-Winged Teal	Lesser Scaup	Ringnecked Duck	Goldeneye	Redhead	Canvasback	% Success	Number of hunts
1	.....	a	21	5	1	4	1	5	2	2	0	0	2	0		
		b	15	5	1	4	1	2	1	0	0	0	2	0	22.6	1
2	.....	a	26	3	5	11	0	14	10	5	0	1	2	1		
		b	14	2	5	6	0	6	4	3	0	1	1	0	26.2	2
3	.....	a	11	2	5	2	0	6	12	4	0	2	1	1		
		b	7	2	5	2	0	5	5	2	0	2	1	1	12.5	1
4	.....	a	17	6	4	3	0	11	14	3	0	1	2	1		
		b	16	6	4	2	0	0	0	0	0	0	0	0	43.0	1
Total		a	95	16	15	20	1	36	36	14	0	4	7	3		
		b	52	15	15	14	1	13	10	5	0	3	4	0		

APPENDIX 3. Species Composition of Waterfowl at North Creek, 1967 (* per cent; + number)

	May 19	May 21	May 30	June 5	June 10	June 14	June 28	July 15
Mallard	4.4*(3)+	5.5 (1)	50 (6)		8.4 (1)	22.2 (2)	22.2(2)	
Am.Widgeon	2.9 (2)				16.7 (2)			
Shoveler	4.4 (3)	11.1 (2)						
Pintail				40 (10)	41.7 (5)	44.5 (4)	55.6(5)	93.5 (14)
B.W.Teal	4.4 (3)		25 (3)	60 (15)	33.3 (4)	33.3 (3)	22.2(2)	6.6 (1)
G.W.Teal		16.6 (3)						
Redhead	37.3 (25)	16.6 (3)	25 (3)					
Canvasback	2.9 (2)	5.5 (1)						
L. Scaun	4.4 (3)	22.2 (4)						
W.W.Scoter	35.8 (24)							
Am.Goldeneye	2.9 (2)							
Gadwall		22.2 (4)						
Others								
Totals	67	18	12	25	12	9	9	15

	July 26	Aug. 3	Aug 12	Aug. 18	Aug 25	Sept 12	Sept. 18	
Mallard	50 (3)	42.0 (8)	25.3(21)	13.6(16)	9.8 (9)	38.2 (39)	47.0 (81)	
Am.Widgeon						4.9 (5)	24.7 (42)	
Shoveler		10.5 (2)	14.4(12)					
Pintail	50 (3)	31.6 (6)	31.3(26)	45.8(54)	50.0(46)	20.6 (21)	12.9 (22)	
B.W.Teal		15.8 (3)	14.4(12)	22.0(26)	20.6(19)	11.7 (12)	14.7 (25)	
G.W.Teal				7.6 (9)	19.6(18)	4.9 (5)		
Redhead			8.4 (7)					
Canvasback								
L.Scaup				7.6 (9)		8.8 (9)		
W.W.Scoter						10.8 (11)		
Am.Goldeneye			6.0 (5)	3.5 (4)				
Gadwall								
Others								
Totals	6	19	83	118	92	102	169	

APPENDIX 4. Species Composition of Waterfowl on South-West Slough, 1967 (* per cent; † number)

	May 31	June 6	June 11	June 12	June 15	June 19	June 27
Mallard	6.9*(2)†	2.8 (1)				6.2 (3)	4.0 (1)
Am.Widgeon	6.9 (2)	8.3 (3)	18.7 (3)	18.2 (4)	19.2 (5)	10.4 (5)	
Shoveler	6.9 (2)	13.9 (5)	12.5 (2)			4.3 (2)	
Pintail	6.9 (2)	5.6 (2)				8.3 (4)	
B.W.Teal	6.9 (2)	16.7 (6)	12.5 (2)	9.1 (2)		4.3 (2)	
G. W. Teal				9.1 (2)		2.1 (1)	4.0 (1)
Redhead		5.6 (2)		13.6 (3)	46.2 (12)	16.7 (5)	24.0 (6)
Canvasback	45.0 (13)	19.5 (7)	25.0 (4)	22.7 (4)	7.7 (2)	14.5 (7)	12.0 (3)
L. Scaup	13.8 (4)		31.2 (5)	31.8 (7)	23.0 (6)	20.8 (10)	28.0 (7)
W. W. Scoter						2.1 (1)	8.0 (2)
Am.Goldeneye	3.4 (1)	19.5 (7)				4.3 (2)	4.0 (1)
Gadwall							8.0 (2)
Others	3.4 (1)				3.9 (1)	6.2 (3)	8.0 (2)
Totals	29	36	16	22	26	48	23

	July 7	July 14	July 27	Aug. 13	Aug. 21	Aug. 23
Mallard	7.7 (2)	21.9 (7)		14.7 (5)	20.5 (8)	19.3 (6)
Am. Widgeon		7.5 (2)	11.1 (2)	17.6 (11)	28.2 (11)	
Shoveler		3.6 (1)				
Pintail	19.2 (5)		5.5 (1)	8.8 (3)	25.6 (10)	16.1 (5)
B.W.Teal			11.1 (2)	23.5 (8)	15.4 (6)	
G. W. Teal			22.2 (4)	20.6 (7)	10.2 (4)	
Redhead	3.8 (1)		27.8 (5)	5.9 (2)		
Canvasback	23.1 (6)			2.9 (1)		
L. Scaun	34.6 (9)			5.9 (2)		
W. W. Scoter	7.7 (2)					
Am.Goldeneye						
Gadwall						
Others	3.8 (1)					
Totals	26	10	14	34	39	11

APPENDIX 5. Species composition of Waterfowl on East Hay Lake, 1967 (* per cent; † number)

	May 29	May 31	June 3	June 9	June 17	June 26	June 29	July 5	July 16	July 25
Mallard		13.3(2)	18.2(6)	15.0(3)	12.9(4)	15.8(3)	11.1(4)		15.4(2)	
Am.Widgeon			-	5.0(1)		10.5(2)	19.4(7)			
Shoveler		6.7(1)	27.3(9)		19.4(6)	10.5(2)	13.9(5)			
Pintail	*15.0(6)†		-	10.0(2)	16.1(5)	21.0(4)	27.8(10)	60.0(12)		
B.W.Teal			27.3(9)	20.0(4)	29.0(9)	31.6(6)	11.1(4)		38.4(5)	47.0(8)
G. W. Teal			6.05(2)		9.7(3)	10.5(2)	13.9(5)			23.5(4)
Redhead	35.0(14)	26.7(4)	12.1(4)		3.2(1)			10.0(2)	7.7(1)	11.8(2)
Canvasback	59.0(20)	26.7(4)	6.05(2)	20.0(4)	3.2(1)					
L.Scaup			3.0(1)		6.4(2)		2.8(1)		38.4(5)	17.6(3)
W. W. Scoter										
Am.Goldeneye				30.0(6)						
Gadwall		26.7(4)						30 (6)		
Others										
Totals	40	15	33	20	31	19	36	20	13	17

	July 30	Aug 2	Aug 10	Aug 21	Aug 22	Aug 24	Aug 26	Sept. 12
Mallard	13.6(6)	9.1(5)	11.7(6)	29.6(87)	48.7(146)	50.1(76)	47.3(39)	61.8(144)
Am.Widgeon	15.9(7)		2.0(1)	1.0(3)	0.3(1)	10.1(14)	10.9(9)	8.2(19)
Shoveler	4.5(2)			1.7(5)	0.3(1)		1.2(1)	3.9(9)
Pintail	41.0(18)	3.6(2)	9.8(5)	16.0(47)	18.4(55)	23.2(32)	26.1(22)	
B.W.Teal	4.5(2)	27.3(15)	21.6(11)		6.7(20)	10.9(15)	7.2(6)	13.7(32)
G. W. Teal	11.4(5)	47.3(26)	53.0(27)	51.7(152)	25.7(77)	0.7(1)	11.5(10)	4.3(10)
Redhead	4.6(2)	5.5(3)						5.6(13)
Canvasback	2.3(1)							2.6(6)
L.Scaup	2.3(1)	7.2(4)	2.0(1)					
W.W.Scoter								
Am.Goldeneye								
Gadwall								
Others								
Totals	44	55	51	294	300	138	87	233